TeVPA Conference 2015

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Book of Abstracts

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Invited Talk: High energy neutrino astrophysics

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Following the first observation of PeV neutrino events and successful measurements of high energy extraterrestrial neutrino flux in the energy region between a few tens of TeV and PeV significantly above the atmospheric neutrino background flux by IceCube, the field of neutrino astrophysics is becoming more and more active. In this contribution, I summarize the recent experimental results from cosmic neutrino observatories, such as IceCube and ANTARES. Theoretical interpretations and their challenges are briefly discussed followed by future prospects of the neutrino astronomy.

Plenary talks / 1

Invited talk: Direct measurements of cosmic-rays in GeV-TeV

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Energy spectra of cosmic-rays in GeV-TeV region have been directly measured by balloons and in space. Particularly cosmic-ray antiparticles can provide unique opportunity to study fundamental physics such as indirect searches for Dark Matter and understanding of its nature. More than four years after AMS (Alpha Magnetic Spectrometer) start taking data on the ISS (International Space Station), the precision has been decreasing to % level. In my talk brief history of direct measurements is summarized and the latest AMS results and their physics implications are discussed.

Plenary talks / 3

Invited talk: Neutrino physics

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Plenary talks / 4

Invited Talk: Recent cosmic-ray anomalies and their interpretation

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In recent years, direct cosmic-ray detectors reached an unprecedented level of precision, allowing to measure new spectral features deviating from longstanding expectations and extrapolations. In this talk, I will review some main theories trying to explain the latest observations of charged cosmic rays. These ideas range from acceleration and propagation effects to additional contributions from local sources or dark-matter annihilation. I will then discuss the implications for indirect dark-matter searches.

Plenary Talks / 5

Invited Talk: The Galactic Gamma-ray sky

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Plenary Talks / 6

Invited Talk: The Extragalactic Gamma-ray sky

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Our knowledge of the extragalactic gamma-ray sky is evolving very rapidly as new data becomes available. I will present recent results on the gamma-ray emission from extragalactic sources based on the latest Fermi-LAT catalogs (3FGL-3LAC and 2FHL), on new large samples of multi-frequency selected gamma-ray and VHE emitting blazars (1WHSP and 2WHSP), and from extensive Monte-Carlo simulations of gamma-ray surveys of blazars. Specific predictions for the present generation of Cherenkov telescopes and for the upcoming CTA will be presented. This will include the number of detectable sources, their redshift distribution, and the contribution of blazars to the extragalactic gamma-ray and VHE background.

Plenary talks / 7

Invited Talk: Theories of VHE emission from pulsar magnetospheres

The Crab pulsar is one of the youngest pulsars in our galaxy. It exhibits the highest spin-down luminosity among the galactic neutron stars and has been observed from radio to VHE. Fermi/LAT reported a detailed phase-resolved spectrum in 0.1-10 GeV, while VERITAS and MAGIC detected pulsed photons in the double peak and the bridge phases in 25GeV-2TeV. In this talk, I will solve the particle accelerator in the Crab pulsar's magnetosphere from the Poisson equation for the electrostatic potential and the Boltzmann equations for electrons, positrons and photons, and demonstrate that these multi-wavelength observations can be reproduced by this outer-magnetospheric model from IR to VHE. I will briefly show that exactly the same method can also be applied to black-hole magnetospheres and that the recent MAGIC detection of the TeV flare from the radio galaxy IC 310 can be reproduced if the supermassive black hole is extremely rotating.

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Invited Talk: Extragalactic Sources of Very High Energy Gamma-Ray Emission: Highlights from Imaging Atmospheric Cherenkov Telescopes

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The very high energy gamma-ray astrophysics with Imaging Atmospheric Cherenkov Telescopes is blooming thanks to the excellent performance of the experiments H.E.S.S., MAGIC and VERITAS. Large fraction of the scientific program of these experiments is devoted to observation of active galactic nuclei (such as blazars and radio galaxies) and follow-ups of gamma-ray burst alerts. In this talk I will highlight the progress of the field in the recent years revealing new and exciting phenomena studying of which answered some of long standing questions but also opened many new ones.

Plenary Talks / 11

Invited Talk: Indirect DM searches

Many dark matter (DM) models predict that DM in a broad range of astrophysical settings could annihilate or decay into Standard Model particles at rates that would be detectable by contemporary telescopes and cosmic-ray experiments. I will review the status of indirect DM searches with a special focus on recent experimental and theoretical developments. I will also consider future observations that might resolve some of the current anomalies, and generally

increase the reach of indirect DM searches.

Plenary Talks / 12

Invited Talk: Status of Direct dark Matter Search

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Plenary Talks / 13

Invited Talk: Future direct search for various types of dark matter

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Modern cosmology requires dark matter (DM) to explain the structure of the visible universe. The nature of DM is totally unknown. One attractive candidate put forward by theory is a weakly interacting massive particle (WIMP), which could be a thermal relic of the Big Bang. The supersymmetric extension of the standard model provides one of the major candidates for DM. With this consideration, worldwide experimental efforts to detect WIMPs have been made and future large-scale projects are currently planned. However, no positive evidence of supersymmetric particles was observed in the large hadron collider experiments so far. This strengthens the interest in investigating a broad range of DM candidate. In this talk, future projects to search for standard WIMPs and experimental approaches to study various types of dark matter candidates are discussed.

Plenary Talks / 17

Invited Talk: Gravitational wave status of searches

Plenary Talks / 18

Invited Talk: Searching for sharp gamma-ray spectral features from dark matter annihilation

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The search for sharp features in the gamma-ray spectrum is a promising approach to identify a signal from dark matter annihilation over the astrophysical backgrounds. In this talk we review different scenarios leading to sharp gamma-ray spectral features and we discuss the current experiments limits as well as the prospects for detection with future instruments.

Plenary Talks / 19

Invited Talk: Particle physics beyond Higgs

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Invited Talk: Future of ground gamma-ray astrophysics

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Reception

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Cartan's Supersymmetry and the Universe

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Cartan has proposed a model of number systems given by octonions and a pair of 4 dimensional vector system. Octonions contains 2 quaternions or a pair of Dirac particles and by the transformation G_{23}, particle-antiparticle transformation occurs, and by the transformations G_{12},G_{123},G_{13} and G_{132}, supersymmetric transformation occur. We extend the model to the system in which quark, leptons, gauge fields and Higgs particles are interacting, and the construct a picture of the universe.

Dark Matter / 25

Charged Q-balls in gauge mediated SUSY breaking models

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It is known that after Affleck-Dine baryogenesis, spatial inhomogeneities of Affleck-Dine field grow into non-topological solitons called Q-balls. In gauge mediated SUSY breaking models, sufficiently large Q-balls with baryon charge are stable while Q-balls with lepton charge can always decay into leptons. For a Q-ball that carries nonzero B and L charges, the difference between the baryonic component and the leptonic component in decay rate may induce nonzero electric charge on the Q-ball. This implies that charged Q-ball, also called gauged Q-ball, may emerge in our universe. We investigate two complex scalar fields, a baryonic scalar field and a leptonic one, in an Abelian gauge theory, and we find stable solutions of gauged Q-balls for different baryon and lepton charges. Those solutions shows that a Coulomb potential arises and the Q-ball becomes electrically charged as expected. It is energetically favored that some amount of leptonic component decays, but there is an upper bound on its amount due to the Coulomb force. The baryonic decay also becomes possible by virtue of electrical repulsion and we find the condition to suppress it so that the charged Q-balls can survive in the universe.

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Radiative Higgs Lepton-Flavor-Violating Decay Mediated by Leptophlic Dark Matter

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In the standard model (SM), Higgs lepton-flavor-violating (LFV) decay is absent and thus it is a good probe to new physics. In this article we study a type of new physics that could lead to large Higgs LFV decay, i.e., leptophlic dark matter (DM) specified by the particle property of DM (a Majorana fermion) and DM-SM mediators (scalar leptons). Different than other similar setups,

here we introduce both the left-handed and right-handed scalar leptons. They allow for large LFV in Higgs decay and thus may explain the tentative Br(h
$ra\tau\mu$) $\sim 1\%$. In particular, we find that the stringent bound from $\tau\mu\gamma$ can be naturally avoided. Aspects of relic density and especially radiative direct detection of the leptonic DM are also investigated.

Dark Matter / 29

Higgs Portal Dark Matter and GeV Gamma-ray Excess

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The recent claim that gamma-ray excess exists in FERMI data has triggerred many interesting discussions. Here we propose several simple higgs-portal dark matter models for explaining the excess. We also compare various channels using global fit.

Plenary Talks / 30

Ultra High Energy Cosmic Rays at the Pierre AugerObservatory after 10 years : results and future

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The Pierre Auger Observatory has been designed to investigate the origin and nature of Ultra High Energy Cosmic rays with energies from 1017 to 1020 eV. We will review some seletected recent results obtained from data of the Pierre Auger Observatory and discuss the implication of these results for assembling a consistent description of the composition, origin and propagation of cosmic rays. We will discuss the open questions that will be adressed by the foreseen upgrade of the Observatory.

Neutrinos / 31

Status and prospects for the Askaryan Radio Array (ARA) cosmogenic neutrino detector

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The Askaryan Radio Array (ARA) is an ultra-high energy (>100 PeV) cosmic neutrino detector which is in phased construction near the South Pole. ARA searches for radio Cherenkov-like emission from particle cascades induced by neutrino interactions in the ice using radio frequency antennas (˜150-800MHz) deployed at a design depth of 200m in the Antarctic ice. A prototype ARA Testbed station was deployed at ˜30m depth in the 2010-2011 season and the first three full ARA stations were deployed in the 2011-2012 and 2012-2013 seasons. We present the status of the array and plans for the near-term construction of a full ARA-37 detector with profound discovery potential for most models of cosmogenic neutrinos from 100 PeV to 100 EeV in energy.

Dark Matter / 32

Test of Self-interacting dark matter and its thermal transport in the Sun

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The halo dark matter (DM) can be gravitationally captured by the Sun. For self-interacting DM (SIDM), we show that the number of DM trapped inside the Sun remains unsuppressed even if the DM-nucleon cross section is negligible. We consider a SIDM model where $U(1)$ gauge symmetry is introduced to account for the DM self-interaction. Such a model naturally leads to isospin violation for DM-nucleon interaction, although isospin symmetry is still allowed as a special case. We show that the indirect detection of DM-induced neutrinos from the Sun can probe those SIDM parameter ranges not reachable by direct detections. Those parameter ranges are either the region with a very small m or the region opened up due to isospin violations. The energy flows in and out of the system include the gravitational capture via DM-nucleon and DM-DM scatterings, the energy dissipation via DM annihilation, and the heat exchange between DM and solar nucleus are studied. The DM temperature can be higher than the core temperature of the Sun. We further explore its impact on the DM indirect search signal.

Gamma-Ray Astrophysics / 33

Gamma-ray production in millisecond pulsar binary systems

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We discuss scenarios which turn to production of gamma-ray emission within the redback type binary systems containing millisecond pulsar and a low mass stellar companion. The millisecond pulsar can eject relativistic leptons from the inner magnetosphere in the rotation powered stage. These leptons, or after additional re-acceleration, can interact with radiation of companion star. In the accretion stage, the accretion disk penetrates the inner pulsar magnetosphere. Leptons from the inner pulsar magnetosphere can interact with the disk radiation. We propose that in both stages gamma-rays can be produced not only in the pulsar mechanism but also in other processes which involve the presence of the companion star.

Dark Matter / 34

A reconstruction scheme for f(T) gravity based on QCD ghost dark energy

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Accelerated expansion of our universe, as evidenced by Supernovae Ia (SNeIa), Cosmic Microwave Background (CMB) radiation anisotropies, Large Scale Structure (LSS) and X-ray experiments, is well documented in literature. A missing energy component, also known as Dark Energy (DE) with negative pressure, is widely considered by scientists as the responsible of this accelerated expansion. DE model, so-called Veneziano ghost DE (GDE), has been proposed in [1]. The key ingredient of this new model is that the Veneziano ghost, which is unphysical in the usual Minkowski spacetime quantum field theory (QFT), exhibits important physical effects in dynamical spacetime or spacetime with non-trivial topology. Veneziano ghost is supposed to exist for solving the U(1) problem in the low-energy effective theory of QCD [2]. The present paper reports a reconstruction scheme for f(T) gravity based on QCD ghost dark energy. Two models of f(T) have been generated and the pressure and density contributions due to torsion have been reconstructed.

Two realistic models have been obtained and the effective equations of state have been studied. Also, the squared speed of sound has been studied to examine the stability of the models. References: [1] F.R. Urban, A.R. Zhitnitsky, Phys. Lett. B 688, 9 (2010). [2] R.-G. Cai, Z.-L. Tuo, H.-B. Zhang, Q. Su, Phys. Rev. D 84, 123501 (2011).

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Neutrino Flavor Ratios Modified by Cosmic Ray Secondary-acceleration

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Acceleration of 's and 's modies the flavor ratio at Earth (at astrophysical sources) of neutrinos produced by pion decay, nu_e : nu_mu : nu_tau , from 1 : 1 : 1 (1 : 2 : 0) to 1 : 1:8 : 1:8 (0 : 1 : 0) at high energy, because pions decay more than muons during secondary-acceleration. The neutrino spectrum accompanies a flat excess, differently from the case of energy losses. With the flavor spectra, we can probe timescales of cosmic-ray acceleration and shock dynamics. We obtain general solutions of convection-diffusion equations and apply to gamma-ray bursts, which may have the flavor modication at around PeV - EeV detectable by IceCube and next-generation experiments.

Gamma-Ray Astrophysics / 36

Gamma-ray emission from the Galactic center and implications of its past activities

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Radiatively inefficient accretion flows (RIAFs) in low-luminosity active galactic nuclei (LLAGNs) have been suggested as cosmic-ray and neutrino sources, which may largely contribute to the observed diffuse neutrino intensity. We show that this scenario naturally predicts hadronic multi-TeV gamma-ray excesses around galactic centers. The protons accelerated in the RIAF in Sagittarius A*(Sgr A)* escape and interact with dense molecular gas surrounding Sgr A*, which is known as the Central Molecular Zone (CMZ), and produce gamma rays as well as neutrinos. Based on a theoretical model that is compatible with the IceCube data, we calculate gamma-ray spectra of the CMZ and find that the gamma rays with ˜< 1TeV may have already been detected with the High Energy Stereoscopic System (HESS), if Sgr A* was more active in the past than it is today as indicated by various observations. Our model predicts that neutrinos should come from the CMZ with a spectrum similar to the gamma-ray spectrum. We also show that such a gamma-ray excess is expected for some nearby galaxies hosting LLAGNs.

Dark Matter / 37

Implications of simulated Milky Way-like haloes for dark matter direct detection

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There is significant astrophysical uncertainty in the interpretation of data from dark matter direct detection experiments, due to the poorly known dark matter distribution at the position of the Sun. I will discuss the local dark matter density and velocity distribution of Milky Way-like galaxies obtained from the high-resolution EAGLE hydrodynamical simulations. To make reliable predictions for direct detection searches, we identify simulated haloes which satisfy the Milky Way observational constraints. Using the dark matter distribution obtained for the selected Milky Way-like simulated haloes, I will present an analysis of current direct detection data.

Plenary Talks / 39

Invited talk: HAWC Results

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The High Altitude Water Cherenkov Observatory (HAWC) is a new and novel TeV gamma-ray detector that was recently completed and began full operation in March 2015. Located on the Sierra Negra volcano, Puebla, Mexico, at an elevation of 4,100m, HAWC is optimized for the detection of gamma rays in the 0.1 - 100˜TeV range. It's 2sr field-of-view and >90% duty cycle make HAWC an ideal instrument for surveying the high-energy sky, searching for new sources, studying extended emission from diffuse sources and monitoring transient and variable sources such as GRBs and AGN. I will describe the HAWC detector and its performance characteristics and report initial results from the first months of operation.

Dark Matter / 41

Search for Event Rate Modulation in XENON100 Electronic Recoil Data

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XENON100 is currently one of the world leading dark matter direct detection experiments using a dual phase Xenon time projection chamber (TPC). The XENON100 experiment has accumulated more than one year of dark matter search data since February 2011 at a background level of 5.3 events/(keV$tonne$day). This data allows to test the interpretation of the long standing DAMA/LIBRA annual modulation observations for certain dark matter models producing electronic recoils. In this talk, we present the new analysis results searching for event rate modulations in the XENON100 electronic recoil data. We demonstrate for the first time that long term stability of dual phase Xenon TPC is sufficient to enable searches for modulation signals in the low energy region. We finally present the search results from un-binned profile likelihood analysis and make comparison with the DAMA/LIBRA annual modulation observation.

Neutrinos / 43

A measurement of the diffuse astrophysical muon neutrino flux using six years of IceCube data

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The IceCube Collaboration has observed a high-energy astrophysical neutrino flux using neutrino candidates with interaction vertices contained within the instrumented volume. A complementary measurement can be done with charged current muon neutrinos where the interaction vertex can be outside the instrumented volume. Due to the large muon range the effective area is significantly larger but the field of view is limited to the northern hemisphere. IceCube data from 2009 through 2015 have been analyzed by a likelihood approach with reconstructed muon energy and zenith angle as observables. The analyzed data consist of about 340,000 muon neutrino candidates with a negligible contribution of atmospheric muons. While the majority of these events are atmospheric neutrinos, the highest energy events are incompatible with that interpretation. In this talk we will present the observation of an astrophysical muon neutrino flux and the measurement of its properties.

Dark Matter / 44

Scalar dark matter with colored partner

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In my talk I will review the case of scalar dark matter model in which case the dark matter candidate couples to the Standard Model (SM) fermions through Yukawa interactions involving a new vector-like fermion. The latter models are already know to give rise to particularly interesting gamma ray signals when the Yukawa coupling is restricted to leptons. In my talk, I will present our latest results associated to a similar Yukawa interactions to SM quarks including constraints and prospects for Direct detection, colliders, and indirect dark matter searches.

Gamma-Ray Astrophysics / 45

MAGIC observations of the February 2014 flare of 1ES 1011+496 applied to the measurement of the Extragalactic Background Light density

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1ES 1011+496 is a blazar located at a redshift z=0.212, revealed as a very-high-energy gamma-ray emitter by the MAGIC telescopes in 2007. In February 2014 the source underwent an unprecedented flaring episode, reaching a peak flux of almost 14 times the flux measured at the time of discovery, before returning to its low state. The MAGIC telescopes observed the source for a total of 17 nights between February 6 and March 7, during which the source displayed a remarkably stable spectral shape (estimated intrinsic photon index around 2) and significant flux variations in timescales of 1 day. The average spectrum during the flare could be well measured up to a few TeV, which makes this an ideal observation for probing the Extragalactic Background Light (EBL) through its effect on the gamma-ray flux. A maximum likelihood method was applied for the simultaneous estimation of the source intrinsic spectral parameters and of the optical depth due to the EBL, using the EBL model by Domínguez et al (2011) as a template to account for the EBL spectrum and evolution. The resulting measurement of the EBL density is among the most constraining ones obtained with gamma-ray telescopes on a single source, and is compatible with current EBL models, strengthening the case for no significant contribution of unresolved sources to the EBL.

Gamma-Ray Astrophysics / 46

Star-Jet Interactions and Gamma-Ray Flares

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We propose a model to explain the ultra-bright GeV gamma-ray flares observed from the blazar 3C454.3. The model is based on the concept of a relativistic jet interacting with compact gas condensations produced when a star (red giant) crosses the jet close to the central black hole. The study includes an analytical treatment of the evolution of the envelop lost by the star within the jet, and calculations of the related high-energy radiation. The model readily explains the day-long, variable on timescales of hours, GeV gamma-ray flare from 3C454.3, observed during November 2010 on top of a weeks-long plateau. In the proposed scenario, the plateau state is caused by a strong wind generated by the heating of the star atmosphere by nonthermal particles accelerated at the jet-star interaction region. The flare itself could be produced by a few clouds of matter lost by the red giant after the initial impact of the jet. In the framework of the proposed scenario, the observations constrain the key model parameters of the source, including the mass of the central black hole: M_BH≃10ˆ9M⊙, the total jet power: L_j≃10ˆ48 erg s−1, and the Doppler factor of the gamma-ray emitting clouds, δ≃20. Whereas we do not specify the particle acceleration mechanisms, the potential gamma-ray production processes are discussed and compared in the context of the proposed model. We argue that synchrotron radiation of protons has certain advantages compared to other radiation channels of directly accelerated electrons.

Gamma-Ray Astrophysics / 47

Recent highlights of the MAGIC telescopes

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MAGIC (Major Atmospheric Gamma Imaging Cherenkov) is a system of two imaging atmospheric Cherenkov telescopes located at the Canary island of La Palma. The telescopes are performing observations of gamma rays with energies between 50 GeV and tens of TeV. In 2014 MAGIC celebrated its 10th anniversary of scientific operations. In this talk I will present the recent highlights of the observations performed with the MAGIC telescopes. I will discuss the ultra-fast variability of IC 310, challenging jet emission models in AGNs. I will present the detection of the VHE gamma-ray emission from two active galaxies located at redshift of ˜0.94: gravitationally lensed blazar B0218+357 and FSRQ PKS 1441+25. Finally, I will also present the newest measurements of the VHE emission from Crab pulsar.

Dark Matter / 49

Dark matter search using fiducial volume analysis in XMASS experiment

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An 800kg liquid xenon detector (XMASS) was constructed at Kamioka Observatory, Japan in 2010. XMASS can be made the low background region in center of detector by shield of the liquid xenon which eliminates the background in detector surface. A commissioning run was conducted from November 2010 to June 2012. We found the unexpected background in detector surface. In order to reduce these backgrounds on detector surface and increase the sensitivity for Dark Mater search, refurbishment of the detector was completed and physics data taking was resumed since Nov 2013. In this presentation, the result of dark matter search using fiducial volume analysis is reported. Also expected background events should be evaluated.

Gamma-Ray Astrophysics / 50

Multiwavelength properties of gamma-ray binary systems

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Several compact binary systems appeared to have spectral energy distributions that peak is gamma-ray energy band. Almost all these sources have been detected in the high energy and very high energy regimes with Fermi/LAT and ground based Cherenkov detectors, respectively. Detection of very high energy photons from these compact sources implies operation of a very efficient particle accelerator in there. Moreover, comparison of the spectra and lightcurves collected with these instruments suggests that there should be present several distinct production sites for gamma-ray emission. Proper implications of these striking facts on particle acceleration theories demands accurate modelling of the physical processes taking place in gamma-ray binary systems. This includes hydrodynamic simulations, calculations of the production and transport of non-thermal emission. In this talk I will present these simulations for two binary systems: LS 5039 and 1FGL J1018.65856.

Gamma-Ray Astrophysics / 51

The Mopra Southern Galactic Plane Molecular Gas Survey - why the CTA needs it

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The Mopra Southern Galactic Plane molecular gas survey is the next generation CO survey of the distribution and dynamics of the molecular gas along the southern galactic plane. Being conducted with 0.6 arcmin and 0.1 km/s resolution, it provides an order of magnitude improvement in both spatial and spectral resolution over the Dame et al 2001 survey, currently our standard source of reference on the distribution of the molecular gas in our Galaxy. It is also being conducted in three isotopologues of the molecule, not just one, so providing information on the optical depth (and hence the column density). Knowledge of the distribution of the molecular gas as a function of distance from the Sun is a key input for the interpretation of TeV gamma ray images, for molecules provide the greatest column densities of nuclei that high energy cosmic rays might collide with, in the hadronic scenario for TeV gamma ray production. With CTA's resolution approaching an arcminute, an order of magnitude improvement on the HESS, it will be essential to know the distribution of the gas on this scale in order to be able to fully interpret the gamma ray images it will produce. The Mopra CO survey is being conducted with the CTA's needs as a primary driver. This talk will describe the status of the Mopra CO survey, and illustrate the difference that the order of magnitude improvement in spatial resolution brings to the cartographic charting of the Galaxy's interstellar medium.
Further details at the project website: www.phys.unsw.edu.au/mopraco

Plenary Talks / 52

Invited talk: Status of the CALorimetric Electron Telescope on the International Space Station

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The CALorimetric Electron Telescope (CALET) space experiment, which had been developed by Japan in collaboration with Italy and the United States, is a high-energy astroparticle physics mission on the International Space Station (ISS). The primary goals of the CALET mission include investigating possible nearby sources of high energy electrons, studying the details of galactic particle propagation and searching for dark matter signatures. During a two-year mission, extendable to five years, the CALET experiment will measure the flux of cosmic-ray electrons (including positrons) to 20 TeV, gamma-rays to 10 TeV and nuclei with Z=1 to 40 to 1000 TeV. The instrument consists of two layers of segmented plastic scintillators for the cosmic-ray charge identification (CHD), a 3 radiation length thick tungsten-scintillating fiber imaging calorimeter(IMC) and a 27 radiation length thick lead-tungstate calorimeter (TASC). CALET has sufficient depth, imaging capabilities and excellent energy resolution to allow for a clear separation between hadrons and electrons and between charged particles and gamma rays. The payload is being prepared for launch on Aug. 16th, 2015 to the ISS with HTV-5 (H-II Transfer Vehicle5) and installed on the Japanese Experiment Module-Exposed Facility (JEM-EF). We will have the first report of the CALET observations on the ISS.

Dark Matter / 54

On muon->electron+photon and (g-2)_muon in Non-Sterile Electroweak Scale Right-Handed Neutrino Models

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An updated analysis on the mu –> e + gamma was performed in a new class of non-sterile electroweak scale right-handed neutrino models with a A_4 symmetry in the neutrino sector. This class of models provide an interesting link between charged lepton flavor violating processes to the physics of neutrino sector. Constraints from the current limit and projected sensitivity from MEG experiment are studied in details. Finally, the anomalous magnetic moment of the muon will be discussed.

Dark Matter / 55

Electroweak physics and Dark Matter: colliders vs sky

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Probing the thermal WIMP paradigm for Dark Matter is one of the primary goals of the high energy physics community. To study the interplay of the LHC with direct and indirect detection experiments, it is necessary to study benchmark WIMP models. I will do so by adding to the Standard Model an electroweak multiplet, which is arguably the simplest way to realise such a study. Besides that, these DM candidates are also motivated by Supersymmetry, Minimal Dark Matter, and strongly-coupled constructions. I will overview the interplay of several different constraints, commenting also on the impact of electroweak corrections, in particular at a futuristic 100 TeV pp collider.

Gamma-Ray Astrophysics / 56

Recent observations of Active Galactic Nuclei with H.E.S.S.

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By upgrading the H.E.S.S. array of Imaging Atmospheric Cherenkov Telescopes with a fifth, 28-m diameter telescope, the sensitivity of H.E.S.S. towards low gamma-ray energies has been extended to energies below 100 GeV. This allows studies particularly of distant Active Galactic Nuclei (AGN) with soft gamma-ray spectra. Results of observations with the five-telescope array will be discussed, including the low-energy view of H.E.S.S. on the blazar-type AGN PKS 2155-304 and PG 1553+113. We also will discuss how low-energy AGN observations will improve our insights on radiation mechanisms in blazars, on the extragalactic background light, but also on fundamental physics topics.

Dark Matter / 57

Distinguishing WIMP-nucleon interactions with directional dark matter experiments

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The framework of non-relativistic effective field theory (NREFT) aims to generalise the standard analysis of direct detection experiments, which is typically framed in terms of spin-dependent (SD) and spin-independent (SI) interactions. I will show that a number of these more general NREFT operators lead to distinctive new directional signatures, such as prominent ring-like features in the directional recoil rate, even for relatively low mass WIMPs. I will focus on how well different operators can be distinguished in directional and non-directional direct detection experiments. In particular, I will show that for certain NREFT operators, directional sensitivity provides the only method of distinguishing them from the standard SI/SD operators, highlighting the importance of directional detectors in probing the particle physics of dark matter.

Neutrinos / 58

Results of the ARAcalTA experiment: measurement of the coherent radio emission from an electron excess in ice.

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The Askaryan Radio Array is a neutrino radio detector array being built at the south pole. It aims at the observation of cosmic ultra high energy neutrino (E > 10PeV) via the coherent radio waves emitted from the charge excess in the cascade induced after the interaction of the neutrinos in ice. The radio signal expected by ARA rely mostly on the simulation of the emission process, the Askaryan radiation, and the detector response. In order to verify both of these aspects, we set up a replica of ARA experiment, ARAcalTA, using the 40 MeV electron beam of the Electron Light Source facility at Telescope Array site. Electron bunches were shot in a block of ice to produce an electromagnetic shower and the resulting radiation was collected with ARA sensors. Parameters such as coherence, polarization ratio and angular distribution were measured. The difficulty in this experiment comes from the estimation of the possible background such as transition radiation and the radiation from the beam appearance. After describing the experimental setup and the presentation of the main measurements, we will interpret our results in the light of the simulation of the various emission process.

Gamma-Ray Astrophysics / 59

Multi-band variability and correlation study of the extraordinary Mrk421 flare in April 2013

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The blazar Mrk 421 is one of the closest and brightest extragalactic very high energy (VHE, >100 GeV) gamma-ray emitters, and hence one of the VHE objects that we can study best. Since 2009, Mrk 421 is yearly observed during 6 months with more than 25 instruments in the framework of broadband multifrequency campaigns. During April 2013, Mrk421 underwent unprecedented flaring activity in many wavelengths, which was densely monitored at VHE by MAGIC and VERITAS (up to fluxes of the order of ˜18 Crab Units above 800 GeV), in the hard X-rays by NuSTAR, in the soft X-rays by Swift-XRT, and by numerous optical facilities. The high sensitivity of the instruments involved, together with the ˜45 hours of strictly simultaneous observations in the VHE and X-ray energy bands during the entire period of the flare (i.e. 10 consecutive days), make this dataset an unique opportunity for unveiling the highly energetic emission on sub-hour timescales. Here we perform detailed correlations studies and an exquisite characterization of the multi-band flux variability of the source. We will also discuss the origin of the VHE emission with our new results.

Neutrinos / 60

High-Energy Neutrinos from Fast-spinning Newborn Pulsars

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Fast-spinning newborn pulsars are promising sources of ultrahigh energy cosmic rays (UHECRs). With proper injection abundances, integrated cosmic rays from the extragalactic pulsar population can match UHE observation in all aspects - energy spectrum, chemical composition, and anisotropy. High-energy neutrinos would be produced unavoidably, when accelerated UHECRs travel through the supernova envelope surrounding the pulsar. In this talk, we will investigate this neutrino production process, including the hadronuclear interaction between cosmic rays and the background, and possible suppression due to the pion interaction. We will report the spectrum, flux and flavor ratio of the high-energy neutrinos from pulsars, and compare their detectability to sensitivities of current and future experiments. Finally, we will discuss our model dependence on the source emissivity, the distribution of pulsar population at birth, as well as the injection composition of cosmic rays.

Dark Matter / 61

Dark matter search from DarkSide

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DarkSide-50 (DS-50) at Gran Sasso underground laboratory, Italy, is a direct dark matter search experiment based on a TPC with liquid argon from underground sources. The DS-50 TPC, with 50 kg of active argon and a fiducial mass of ˜37 kg, is installed inside an active neutron veto based on a boron-loaded organic scintillator. The neutron veto is built inside a water cherenkov muon veto. DS-50 has been taking data since Nov 2013, collecting 47 days livetime of data with atmospheric argon. Also, recently DS-50 commissioned liquid Ar from underground and measured the level of radioactive 39Ar. The first physics result from DarkSide as well as underground argon performance will be presented. This is the most sensitive dark matter search preformed with an argon target.

Gamma-Ray Astrophysics / 62

Radial gradients in cosmic-ray transport: Implications for TeV gamma and neutrino astronomy.

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The Fermi-LAT measurements of the diffuse Galactic gamma-ray emission reveal a hardening of the cosmic-ray (CR) spectrum with decreasing Galactocentric radius. This result can be the signature of different CR trasport properties in the inner Galaxy, and in particular a harder rigidity scaling of the diffusion coefficient. We model this effect with DRAGON and we provide a good description of both Fermi-LAT gamma-ray data in the most relevant sky windows and local cosmic-ray measurements by PAMELA, AMS-02 and CREAM.
Our model is in remarkably good agreement with the gamma-ray flux measured by MILAGRO at 15 TeV from the inner Galactic plane region, and with H.E.S.S. data from the Galactic ridge. On the neutrino side, we show that our scenario provides an explanation for a significant fraction of the astrophysical flux measured by IceCube above 25 TeV; moreover, we discuss how the neutrino telescopes in the Northern hemisphere (ANTARES and the future KM3NeT), better positioned for the observation of the Galactic Ridge, will be able to confirm or constrain our picture.

Dark Matter / 63

The electron plus positron spectrum from annihilation of Kaluza-Klein dark matter and comparison with recent measurements

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One of the good candidates for cold dark matter is the lightest Kaluza-Klein particle (LKP),which produce electrons and positrons by pair annihilation in the Galactic halo. The directions of electrons and positrons are randomized by the Galactic magnetic field, and the energy is reduced by some energy loss mechanisms, when the charged particles propagate in the Universe. We calculate the observed electron and positron spectra expected from the LKP annihilation taking account of propagation effect, such as bremsstrahlung. The spectra include the electron-positron component from two-body decays and “continuum” emission, which is produced by LKP annihilation via muon pair, tauon pair, quark pair, and gauge bosons. We compare the spectra with recent observational data, and we can set some constraints on the boost factor, which indicates the dark matter concentration in the Galactic halo. In addition, we will discuss the recent results of positron excess in high energy region based on our calculation.

Neutrinos / 64

High-energy Particle Emission and Cumulative Background from Low-Luminosity Active Galactic Nuclei

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The origin of high-energy neutrinos detected by the IceCube neutrino telescope is a big mystery of high-energy astrophysics. We propose low-luminosity active galactic nuclei (LLAGNs) as a novel source of the high-energy neutrinos. The radiation inefficient accretion flows (RIAFs) are believed to exist in LLAGNs. The Coulomb collisions inside RIAFs is so inefficient that plasmas naturally have high-energy protons through the stochastic particle acceleration. We calculate spectra of escaping neutrinos and cosmic-ray (CR) protons, and find that the RIAFs in LLAGNs can accelerate protons up to ˜ PeVs and emit TeV–PeV neutrinos via pp and/or pγ reactions. If ˜ 1% of the accretion luminosity is carried away by non-thermal protons, the diffuse neutrino intensity from the RIAFs in LLAGN can be compatible with the observed IceCube data (Kimura, Murase & Toma 2015, ApJ, 806, 159). This result does not contradict either of the diffuse gamma-ray background observed by Fermi or observed diffuse CR flux. This model can be tested by gamma-ray observations around the cores of LLAGNs (e.g., Fujita, Kimura, Murase 2015, PRD, 92, 023001).

Gamma-Ray Astrophysics / 65

Testing the Millisecond Pulsar Scenario of the Galactic Center Gamma-Ray Excess With Very High Energy Gamma-Rays

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Recent analyses of Fermi Large Area Telescope data show an extended GeV γ-ray excess on top of the expected diffuse background in the Galactic center region, which can be explained by annihilating dark matter (DM) or a population of millisecond pulsars (MSPs). We propose observations of very high energy (VHE) γ-rays to distinguish the MSP scenario from the DM scenario. GeV γ-ray MSPs should release most of their energy to the relativistic e± wind, which will diffuse into the Galaxy and radiate TeV γ-rays through inverse Compton scattering and bremsstrahlung processes. By calculating the spectrum and spatial distribution, we show that such emission is detectable with the next generation VHE γ-ray observatory, the Cherenkov Telescope Array (CTA), under reasonable model parameters. It is essential to search for multi-wavelength counterparts to the GeV γ-ray excess in order to solve this mystery in the high-energy universe.

Dark Matter / 66

Gamma ray tests of Minimal Dark Matter

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We reconsider the model of Minimal Dark Matter (a fermionic, hypercharge-less quintuplet of the EW interactions) and precisely compute its gamma ray signals. We compare them with a number of gamma-ray probes: the galactic halo diffuse measurements, the galactic center line searches and recent dwarf galaxies observations. We find that the original minimal model, whose mass is fixed at 9.4 TeV by the relic abundance requirement, is particularly constrained by the line searches: it is ruled out if the Milky Way possesses a cuspy profile such as NFW but it is still allowed if it has a cored one. Searches of gamma-ray lines from dwarf spheroidal galaxies are also particularly relevant, and ongoing astrophysical progresses have the potential to eventually rule out the model. We also explore a wider mass range. Furthermore, most of our results can be safely extended to the larger class of multi-TeV WIMP DM annihilating into massive gauge bosons.

Dark Matter / 68

Prospect for indirect Dark Matter searches with the Cherenkov Telescope Array

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The nature of dark matter (DM) is an open issue of modern physics. Cosmological considerations and observational evidences indicate a behaviour beyond the Standard Model for optimal dark matter particle candidates. The non-baryonic dark matter is compatible with a gas of cold and weakly interacting massive particles (WIMPs) expected to have a mass in the range between O(10)GeV and O(100)TeV. Indirect DM searches with imaging atmospheric Cherenkov telescopes (IACTs) may play a crucial role in constraining the nature of the DM particle(s) through the study of their annihilation in very high energy (VHE) gamma rays from promising targets, such as the Galactic Center (GC) and the dwarf spheroidal galaxies (dSphs) of the Milky Way. In this contribution, we focus on indirect DM searches prospects for the next-generation gamma-ray Cherenkov Telescope Array (CTA) observatory.

Gamma-Ray Astrophysics / 70

The very high energy gamma-ray diffuse emission in the Galactic Center region as seen by H.E.S.S

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The Very High Energy (VHE) emission from the Galactic Center Ridge was revealed by H.E.S.S. in 2006, after subtraction of the two bright point sources HESS J1745-290 possibly associated with Sgr A*, and HESS J1747-281 associated with the composite supernova remnant G0.9+0.1. The hard spectrum of the Ridge emission and its spatial correlation with the local gas density suggest that the emission is due to collisions of multi-TeV cosmic rays with the dense clouds of interstellar gas present in this region. The much larger H.E.S.S. dataset (250 hrs) that is now available from this region and the improved analysis method dedicated to the detection of faint

emission allow us to reconsider the characterization of this gamma-ray emission through a detailed morphology study and the extraction of the total energy spectrum with much better accuracy. To test the various contributions to the total gamma-ray emission, we use a 2D maximum likelihood approach that allows to constrain a phenomenological model of the signal. We discuss the nature of the various components, their implication on the cosmic-ray distribution in the central region of our Galaxy, and their possible connection with HESS J1747-281. Finally, we reveal an additional source in this region and discuss its potential nature.

Gamma-Ray Astrophysics / 71

Multimessenger test of hadronic model for Fermi bubbles

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The Fermi bubbles at the Galactic center have been imaged in sub-TeV gamma rays by the Fermi-Large Area Telescope and might have been detected in 0.3-1 PeV neutrinos by the IceCube Neutrino Observatory. A hadronic model, involving cosmic-ray interactions in the bubble volumes, can account for both gamma-ray and neutrino observations but is far from being confirmed due to low neutrino statistics. We present a possibility to test the hadronic model using 0.1-100 TeV gamma-ray observations by the High Altitude Water Cherenkov (HAWC) detector which has recently started its operation. HAWC will either substantiate hadronic model, establishing Fermi bubbles as the first mulimessenger source, or will severely constrain hadronic origin of sub-TeV gamma rays.

Cosmic Rays / 72

Cosmic-ray hardenings in the light of AMS-02

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Recent precise observations of cosmic rays (CRs) by AMS-02 experiment clearly show (1) harder spectra of helium and carbon compared to protons by $proptoR^{0.08}$, and (2) concave breaks in proton and helium spectra at a rigidity $Rsim300$ GV. In particular the helium and carbon spectra are exactly similar, pointing to the same acceleration site. We examine possible interpretations of these features and identify a chemically enriched region, that is, superbubbles as the most probable origin of Galactic CRs. We further show that CRs originate primarily from the supernova ejecta in the superbubble core, mixed with negligible interstellar medium, and predict similar spectra for heavy nuclei.

Neutrinos / 73

Enhanced sensitivity to astrophysical neutrinos with a surface veto array above IceCube

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The IceCube neutrino observatory features a kilometer-cubed deep detector and a surface component, IceTop, instrumenting the square-kilometer footprint of the detector. IceTop consists

of ice-filled tanks equipped with optical sensors capable of detecting charged particles produced in air showers. Besides measuring the cosmic-ray spectrum and composition, IceTop can be used as a veto for IceCube. With the discovery of an astrophysical flux at high energy, this role is becoming more important as a pathway to the design of a larger surface array. Since the earth is not transparent to very-high-energy neutrinos, searching for a signal from the southern hemisphere is a priority. This search, however, requires suppressing a large background consisting of penetrating atmospheric muons and neutrinos. A surface array, such as IceTop, can reduce the background by identifying particles which are generated in the same air shower as the muons in the deep detector. I will present the capabilities and limitations of IceTop as a veto for cosmic rays as well as the status of simulations of various designs for an upgraded surface array.

Gamma-Ray Astrophysics / 74

Extending Fermi-LAT discoveries: Compton-Pair Production Space Telescope (ComPair) for MeV Gamma-ray Astronomy

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The gamma-ray energy range from a few hundred keV to a few hundred MeV has remained largely unexplored, mainly due to the challenging nature of the measurements, since the pioneering but limited observations by COMPTEL on the Compton Gamma-Ray Observatory (1991-2000). This energy regime encompasses the transition between thermal and nonthermal processes, and accurate measurements are critical for answering a broad range of astrophysical questions. We are developing a concept for a discovery mission, ComPair (Compton-Pair Production Space Telescope), to investigate energies from 200 keV to $>$ 500 MeV with high energy and angular resolution and with sensitivity approaching a factor of 100 better than COMPTEL. This instrument will be capable of detecting both Compton-scattering events at lower energy and pair-production events at higher energy. ComPair will build on the heritage of successful space missions including Fermi, AGILE, AMS and PAMELA, and will use well-developed space-qualified detector technologies including Si-strip and CdZnTe-strip detectors, heavy inorganic scintillators, and plastic scintillators.

Dark Matter / 75

Searching for Singlet Majorana dark matter.

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We are searching the Singlet Majorana dark matter (DM) by using constraints from relic density, colliders (LHC and LEP), DM direct detection, and DM indirect detection. By the means of effective field theory (EFT), we write down several kinds of higher dimensional operators and show the allowed parameter space by current experiments in DM mass and cut-off scale plane. Furthermore, we also try to explore the parameter space where EFT is invalid. We propose a method to fix this problem by connecting the EFT with several simplified models, which allows us to make a robust prediction on DM collider signals.

Gamma-Ray Astrophysics / 76

Stochastic Particle Acceleration and Photon Emission in Blazars

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Multi-wavelength observations of blazars have revealed curved feature in photon spectrum. Moreover, in some cases, the required electron spectral index at injection becomes harder than 2. In order to reproduce such a curved electron spectrum, we discuss the second order Fermi acceleration by turbulence in the jet. Here, we focus on the time-dependent effects of the electron acceleration and injection. We numerically follow the temporal evolution of the electron spectrum in the jet. We show that the resultant photon spectra well agree with the various observed spectra of 1ES 1101, Mrk 421, and 3C 279. Especially, the light curve and spectrum of the recent intensive flare in 3C 279 are both reproduced by our simple model. Therefore, this stochastic acceleration model can be a reasonable explanation for the electron acceleration in blazars.

Cosmic Rays / 77

Nonrelativistic shocks of young supernova remnants in kinetic simulations

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The formation, electromagnetic structure, and the injection of suprathermal particles into a Fermi-type acceleration at collisionless shocks constitute important problems of high-energy astrophysics. We report on recent particle-in-cell studies of high Mach-number nonrelativistic perpendicular shocks in applications to young supernova remnants. We discuss a nonlinear shock structure mediated by Weibel-type filamentation instabilities, shock reformation and rippling, and conditions leading to heating and efficient electron and ion pre-acceleration. First results of oblique quasi-perpendicular shock studies will also be presented.

Dark Matter / 78

Dark Matter Sensitivity of CALET

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CALET (Calorimetric Electron Telescope), launched to the ISS in August, directly measures the electron+positron cosmic rays flux up to 20 TeV. With its proton rejection capability of 1 : 10ˆ5 and an aperture of 1200 cmˆ2 sr, it will provide good statistics even well above one TeV, while also featuring an energy resolution of 2%, which allows it to detect fine structures in the spectrum. Such structures may originate from Dark Matter annihilation or decay, making indirect Dark Matter search one of CALET's main science objectives among others, such as

identification of signatures from nearby supernova remnants by observation of TeV electrons, and measurement of the heavy nuclei spectra to study the cosmic ray acceleration and diffusion mechanism. The positron excess in cosmic rays above 10 GeV was initially proposed by the AMS-02 collaboration to originate from an extra power law source with exponential cut-off, which emits an equal amount of electrons and positrons. The latest results from AMS-02 on positron fraction and total electron+positron flux can be fitted with a parametrization including such an extra power law source, which in general may represent nearby astrophysical accelerators or annihilation/decay of Dark Matter. Assuming that the source is a single pulsar, this scenario is extrapolated into the TeV-region and the expected CALET data for this case simulated. Based on this prediction and taking the shape of the Dark Matter annihilation spectrum into account, the sensitivity of CALET to an additional component from Dark Matter annihilation in the galactic halo has been calculated. It is shown that CALET could significantly improve these limits compared to current data, especially for those Dark Matter candidates that feature a large fraction of annihilation directly into electron+positron, such as the LKP (Lightest Kaluza-Klein particle). The alternative case of Dark Matter annihilation or decay being the primary cause of the positron excess and the prospects of CALET detecting the corresponding Dark Matter signature are discussed as well.

Gamma-Ray Astrophysics / 79

Broadband Emission of Magnetar Wind Nebulae

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Rotation-powered pulsars release their rotational energy as relativistic magnetized plasma and create pulsar wind nebulae (PWNe) around them. Although magnetars are considered as magnetically powered pulsar, they also release their rotational energy by the wind. This is obvious from the fact that they are spinning down. We have been detected PWNe around energetic pulsars which have spin-down power of more than 10^36 erg/s, typically. In this study, we consider the wind nebula around magnetars (MWN). Although they have relatively small spin-down power, magnetars would have had a large spin-down power at their birth because they spin down rapidly. Here, we construct an one-zone spectral model of MWN considering spin-down evolution of magnetar and apply to some objects which are claimed to have MWN in X-rays.

Gamma-Ray Astrophysics / 81

Spying on the next-door blazar Markarian 501 during multiple years

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We present recent results on the high-frequency-peaked BL Lac object Markarian 501 derived from extensive multi-wavelength campaigns in the years 2009, 2012 and 2013. The blazar is located in our extragalactic neighborhood (z=0.034), which reduces spectral uncertainties due to absorption effects of the Extragalactic Background Light and allows for significant detections on sub-hour timescales, thus permitting precise studies of its multi-band flux variability and evolution of its broadband spectral energy distribution. We will present the first broadband SED

that includes the sensitive hard X-ray data from NuSTAR, the first light curves with FACT compared to those of MAGIC and VERITAS, and we will report about the first physics result obtained with Cherenkov telescope data taken under challenging atmospheric conditions and corrected with information from the MAGIC LIDAR. We will show that also in the HBL Mrk 501 a rotation of the optical polarisation vector can be measured coinciding with gamma-ray flares, as it was observed in LBLs and FSRQs. We will also discuss the finding that the X-ray and gamma-ray spectra of Mrk 501 can be harder than those of many known extreme blazars, suggesting that being "extreme" may be a temporal state rather than an intrinsic characteristic of a blazar. A novel technique to model broadband SEDs with a substantially smaller bias in terms of assumptions will also be presented, leading to the conclusions that some SSC model parameters can be strongly constrained by the data, while others not, and that the broadband SED of Mrk 501 during a flaring state can also be successfully modelled with Doppler factors one order of magnitude smaller than those typically used in the literature.

Gamma-Ray Astrophysics / 82

Determination of the extragalactic background light spectral energy distribution with H.E.S.S.

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When very high-energy photons (VHE, E>100 GeV) propagate over cosmological distances, they interact with background light by pair production. Observations of spectral features in the VHE band of extragalactic sources related to this energy-dependent absorption process with the H.E.S.S. array of Cherenkov telescopes allow measuring the spectral energy distribution (SED) of the extragalactic background light (EBL), otherwise very difficult to determine. Preliminary results on the determination of the SED of the EBL will be presented, based on the measurements of the energy spectra of blazars with H.E.S.S. . This model independent approach shows that the shape and overall normalization of the EBL SED is accessible.

Gamma-Ray Astrophysics / 84

MAGIC VHE gamma-ray observations of transient and variable stellar objects

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There are several types of Galactic sources that can potentially accelerate charged particles up to GeV and TeV energies. These accelerated particles can produce Very High Energy (VHE) gamma-ray emission through different processes, for example inverse Compton scattering of ambient photon fields by accelerated electrons. We study various transient and variable stellar objects in the VHE regime using observations made with the MAGIC telescopes. In this talk we will present data from four sources: LS I +61 303, Cygnus X-1, MWC 656 and SS433. The two binary systems LS I +61Âº 303 and Cygnus X-1 were observed in long-term monitoring campaigns, eight and seven years, respectively. For LS I +61 303 we will present the latest results of our search for superorbital variability combined with contemporaneous optical observations. The microquasar Cygnus X-1, one of the brightest X-ray sources, has been well studied along a broad range of wavelengths. Here we present a search for steady and variable signal using combined X-ray and MAGIC observations. MWC 656 is a unique high-mass X-ray binary system as it is the only known binary to be composed of a Be star and a black hole. Finally, we will present our observations of the only super-critical accretion system known in our galaxy: SS433.

Dark Matter / 85

Towards a refined understanding of the Galactic Center excess

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There is a striking evidence for a roughly spherical-symmetric diffuse gamma-ray signal peaked in the Galactic Center (GC) region, extended up to several degrees off the GC. Here we critically review the main points regarding the derivation of this signal, characterized by means of the template-fitting method. In particular we focus our attention on the usual Inverse Compton (IC) component adopted for the background emission, finding that it does not provide a realistic description of the complex GC environment. Driven by the evidence of a large gas density in the inner kpc of the Galaxy correlated with an impressive Supernova rate (2 order of magnitude larger than the Galactic average), and therefore with ongoing CR acceleration, we are able to show that no clear evidence of the aforementioned excess comes out when a possibly more realistic diffuse CR source term is taken into account.

Dark Matter / 86

The Extragalactic Radio Background from Dark Matter Annihilation and the ARCADE-2 Excess

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Observations of the ARCADE-2 and other telescopes have reported a significant isotropic emission spanning from 22 MHz to 10 GHz. The intensity of this signal significantly exceeds the expected contribution from known astrophysical sources, and the distribution of the signal is suggested to be unusually smooth compared to emission which traces large scale structure. In this talk, we investigate the extragalactic radio background from dark matter annihilation and its possible connection to the ARCADE-2 excess signal. We show that with assumptions of strong magnetic fields and extended substructure in massive clusters, dark matter models can explain both intensity and spectrum of the ARCADE-2 excess, while produce small anisotropies that remain consistent with observational constraints. We also demonstrate that the above constraints could be significantly relaxed in an alternative scenario where electrons from the annihilation could be re-accelerated by turbulence in the intra-cluster medium.

Cosmic Rays / 87

Can we explain AMS-02 antiproton and positron excesses simultaneously?

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I explain the excess of the antiproton fraction recently reported by the AMS-02 experiment by considering collisions between cosmic-ray protons accelerated by a local supernova remnant (SNR) and the surrounding dense cloud. The same “pp collisions” provide the right branching fraction to fit the observed positron excess simultaneously without a fine tuning. The supernova happened in relatively lower metalicity than the majorcosmic-ray sources. The cutoff energy of electrons marks the supernova age of ˜10ˆ5 years, while the antiproton excess may extend to higher energy.

Both antiproton and positron fluxes are completely consistent with our predictions in Fujita, Kohri, Yamazaki and Ioka (2009).

Cosmic Rays / 88

The Electron Spectrum with MAGIC

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Very high energy (E>100 GeV) cosmic electrons and positrons reaching Earth from beyond the solar system are important tracers of recent energetic events in our galactic neighbourhood. Rapid energy losses due to synchrotron radiation and inverse Compton processes result in typical lifetimes of these energetic particles of less than 10ˆ5 years. Their mean free path in the Galaxy is O(1-2) Kpc. Measurements of the flux distribution of this radiation therefore provide valuable checks in our galaxy for pulsars physics and some of the more exotic dark matter models. The MAGIC experiment, a stereoscopic system of two Cherenkov telescopes, can measure the total flux of cosmic electrons and positrons at very high energies between a few 100GeV and a few TeV. Such a measurement will allow to confirm the results provided by other experiments such as Fermi-LAT, AMS2 as well as give a first cross-check of the results from H.E.S.S.. We have analyzed ˜60h of MAGIC observations with a field of view of 3.5degrees with improved MC statistics. We applied a dedicated, more aggressive, image cleaning and have improved the quality selection as well as the background normalization. This results in the measurement of the electron-positron flux measurement between 200GeV and 2TeV.

Dark Matter / 89

Strong support for a millisecond pulsar origin of the galactic center GeV excess

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Using gamma-ray data from the Fermi Large Area Telescope, various groups have identified an excess emission in the inner Galaxy centred around energies of a few GeV. This excess resembles remarkably well a signal from dark matter annihilation. One of the most plausible astrophysical interpretations is in terms of the combined emission from an undetected population of dim gamma-ray sources. In particular, millisecond pulsars are the best candidates due to their spectral similarity to the excess emission. We search for this hypothetical source population using a novel approach based on a wavelet decomposition of the gamma-ray sky and using the latest pass 8 data. Assuming a spatial distribution compatible with the GeV excess emission, we find evidence for the existence of such a population of dim sources in the inner galaxy at high significance. For plausible values of the luminosity function, this component can explain 100% of the observed excess emission.

Dark Matter / 90

Dark matter density profiles in dwarf satellites

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Dwarf spheroidal satellites of the Milky Way are a prime target for dark matter indirect searches. E.g., upper limits on gamma-ray fluxes in their directions, obtained with the Fermi Large Area Telescope, have been recently used to update constraints on weakly interacting massive particles (WIMPs), excluding pair annihilating cross sections at the level of WIMP thermal relic cross sections for WIMP masses lighter than about 100 GeV. The mapping of a limit on the flux onto a limit on particle dark matter properties stems from the knowledge one has regarding the distribution of dark matter in each dwarf. Such dark matter density profiles are usually derived assuming that dwarfs are equilibrium, pressure-supported, spherical systems, and implementing the spherical Jeans equation to link mass profiles to stellar velocity dispersions. This link requires assumptions regarding quantities like the stellar anisotropy profiles, which are not measurable and are usually treated as nuisance parameters over which to marginalize. We propose here a novel approach to infer the dark matter mass profiles, based on the analytical inversion of the spherical Jeans equation. This methods allows us revisit the so-called mass-anisotropy degeneracy problem, and more direct assessments of the uncertainties on line-of-sight integrals of dark matter halo density profiles. Implications for dark matter indirect detection limits are discussed.

Dark Matter / 91

Complementarity of direct detection and collider searches for Higgs portal DM

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In this talk, I will describe complementarity of direct detection and collider searches for Higgs portal DM models, and show that it is essential to work in renormalizable and gauge invariant DM models for collider searches (both the invisible Higgs decay and the monojet (or dijet) + missing ET). In particular we derive the bounds on new physics scale within a UV model, and show that it is completely different from those presented by ATLAS and CMS Collaborations based on simple mediator models.
Refs: (1) arXiv:1405.3530 (Phys.Rev. D90 (2014) 5, 055014) (2) arXiv:1506.06556, and works in preparation

Neutrinos / 92

Recent results from the ANTARES deep-sea neutrino telescope

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The ANTARES detector, located in the deep Mediterranean sea off the coast of Toulon (France), is the first deep-sea neutrino telescope and has been running in its final configuration since 2008. It consists of a 3D array of 885 photomultipliers distributed on 12 lines anchored on the sea bed,

that detect the Cherenkov light induced by upward-going charged leptons produced by neutrino interactions in and around the detector.
The primary goal of ANTARES is to search for astrophysical neutrinos in the TeV-PeV range. This comprises generic searches for any diffuse cosmic neutrino flux as well as more specific searches for astrophysical sources such as active galactic nuclei or Galactic sources. The search program also includes multi-messenger analyses requiring time and/or space coincidences with other cosmic probes (cosmic rays, gamma rays or gravitational waves).
Thanks to its location in the Northern hemisphere and its excellent pointing accuracy, ANTARES is a privileged observer of the central part of our galaxy. This allows it to put interesting constraints on the origin of the signal reported by the IceCube collaboration. The ANTARES sensitivity is also high enough to study a wide-range of other phenomena, from atmospheric neutrino oscillations to dark matter annihilation or potential exotics such as nuclearites and magnetic monopoles.
This contribution will present the most recent results obtained by the collaboration in the fields mentioned above.

Cosmic Rays / 93

Precision research of cosmic rays from space with PAMELA detector: Results and perspectives

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The Pamela spectrometer was launched in 2006 from the cosmodrome of Baikonur, Kazakistan, on board the Russian satellite Resurs-DK1. Since then, it has been collecting cosmic rays from its 70 degrees inclination, 600 km altitude polar orbit. This orbit allows to sample particles of trapped, semi-trapped nature in the Earth geomagnetosphere, of solar origin (emitted in solar particle events), of galactic origin (modulated by solar activity). Antiparticles of galactic origin can constrain and provide information on the dark matter component in the galaxy. Furthermore the Proton and Helium spectra provide detail information on the acceleration and propagation processes in the galaxy. At lower enegy, particles of solar and trapped nature provide crucial clues on the acceleration and propagation processes in the Heliopshere. In this talk we will discuss some of these recent results of Pamela and the implication for various fields of research.

Gamma-Ray Astrophysics / 94

Pulsations from the Vela Pulsar down to 20GeV with H.E.S.S. II

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The Vela pulsar (PSR J0835 − 4510) is the brightest persistent source in the high-energy γ-ray sky. It is a relatively near, young and energetic rotation-powered pulsar. Vela was a key target for the High Energy Stereoscopic System phase II array (H.E.S.S. II). Observations were carried out following a hint of pulsed emission above 20GeV seen using Fermi-LAT data. In this talk we

present detailed results from the analysis of data only from the new 28m telescope in monoscopic mode. A high-significance pulsed emission is detected. The low-energy performance of the H.E.S.S. II instrument in monoscopic mode is clearly demonstrated given a distinct pulsed excess down to energies of 20GeV. The H.E.S.S. II data provide a thorough insight into the general phase profile of the Vela pulsar and reveal the specific pulse shape at these energies.

Cosmic Rays / 95

Study of Ultra-High-Energy Cosmic Rays from space with K-EUSO detector: status and perspectives

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KLYPVE/K-EUSO is a detector designed to detect and study Ultra-High-Energy Cosmic Rays (UHECR) from space. It is Russian mission to be located on the International Space Station. It consists of a 3.6m diameter mirror which reflects UV light from UHECR on a Fresnel lens, in turn focusing the signal on a 1.4m focal surface. The focal surface is made up of 1872, 64 channel Hamamatsu PMTs for a total of about 120kchannels. The Fresnel lens and the PMTs of the Focal surface will be provided by the Japanese part of the collaboration, with electronics and other parts built in Europe and other countries. In this presentation we will discuss the status of the mission in light also of the results of the ground- and balloon-based precursors.

Dark Matter / 96

Modelling the flux distribution function of the extragalactic gamma-ray background from dark matter annihilation

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The one-point function (i.e., the isotropic flux distribution) is a complementary method to (anisotropic) two-point correlations in searches for a gamma-ray dark matter annihilation signature. Using analytical models of structure formation and dark matter halo properties, we compute the gamma-ray flux distribution due to annihilations in extragalactic dark matter halos, as it would be observed by the Fermi Large Area Telescope. Combining the central limit theorem and Monte Carlo sampling, we show that the flux distribution takes the form of a narrow Gaussian of 'diffuse' light, with an 'unresolved point source' power-law tail as a result of bright halos. We argue that this background due to dark matter constitutes an irreducible and significant background component for point-source annihilation searches with galaxy clusters and dwarf spheroidal galaxies, modifying the predicted signal-to-noise ratio. A study of astrophysical backgrounds to this signal reveals that the shape of the total gamma-ray flux distribution is very sensitive to the contribution of a dark matter component, allowing us to forecast promising one-point upper limits on the annihilation cross section. We show that by using the flux distribution at only one energy bin, one can probe the canonical cross section required for explaining the relic density, for dark matter of masses around tens of GeV.

Gamma-Ray Astrophysics / 97

H.E.S.S. multi-messenger and real-time follow-up observations

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In this contribution the H.E.S.S. programs to follow up on multi-wavelength and multi-messenger observations and alerts will be presented. Ongoing activities searching for high-energy gamma-ray emission in coincidence with Gamma Ray Bursts, recent extensions to Fast Radio Bursts and (in the future) gravitational waves are going to be discussed. Furthermore the newly installed H.E.S.S. multi-messenger program will be introduced, showing for example first results on the combination of high-energy neutrinos and high-energy gamma rays and discussing possible future extensions.

Dark Matter / 98

The VERITAS Dark Matter and Astroparticle Program

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VERITAS, an array of atmospheric Cherenkov telescopes is sensitive to VHE gamma rays in the 85 GeV-30 TeV energy range. VERITAS has a wide scientific reach including observations of supernova remnants, pulsars, pulsar wind nebulae, active galactic nuclei, among others. This presentation will focus on recent developments of the various astroparticle science topics by members of the VERITAS collaboration, including the search for dark matter (DM). The possible astrophysical objects considered to be candidates for indirect DM detection are dwarf spheroidal galaxies (dSphs) of the Local Group and the Galactic Center among others. Results of a combined search for DM of four dSphs will be reported along with a spectrum cosmic-ray electrons, constraints on the inter-galactic magnetic field and other astroparticle physics topics.

Dark Matter / 99

Dark Matter Direct Detection at the Ton Scale with the XENON Experiment

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For over a decade the XENON Collaboration has been a pioneer in the field of dark matter direct detection. The collaboration has achieved world-leading sensitivities in WIMP-nucleon interactions using liquid xenon time projection chambers (TPCs), first with the XENON10 and later with the XENON100 experiments. This year the next phase, XENON1T, will begin data-taking with an unprecedented one ton fiducial (three tons total) volume of ultra pure liquid xenon as both target and detection medium, and should reach sensitivities down to 10-47 cm2 after two ton years of exposure. The upgrade to the ton scale is only possible due to a massive research and development program encompassing every aspect of the detector. This program is ongoing and will enable a seamless upgrade from XENON1T to a true multi-ton detector, XENONnT, with the goal of an order of magnitude increase in sensitivity. XENONnT will reuse the XENON1T infrastructure but feature a 7 ton active volume. It will be the penultimate iteration leading to the DARWIN experiment, a 30 ton liquid xenon WIMP detector designed to reach sensitivities down to 10-49 cm2. This talk will discuss the current and future stages of the XENON experiment in the context of the global dark matter search.

Dark Matter / 100

Low-mass WIMP results and prospects with the EDELWEISS-III experiment

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The EDELWEISS-III collaboration is operating an experiment for the direct detection of WIMP dark matter in the low radioactivity environment of the Modane Underground Laboratory. It consists of 36 advanced "FID" germanium detectors operating at 18 mK in a dilution refrigerator in order to identify eventual rare nuclear recoils induced by elastic scattering of WIMPs from our Galactic halo. After a brief discussion on the backgrounds and rejection method with the FID detectors, a first low-mass WIMP search using data acquired in a long-term campaign will be presented. I will also present the prospects for these detectors to explore uncharted parameter space for WIMPs in the GeV - 10 GeV domain.

Dark Matter / 101

Update on GAMBIT

SCOTT, ON BEHALF OF THE GAMBIT COLLABORATION, Pat[1]

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I will give an update on GAMBIT, the Global And Modular BSM Inference Tool. GAMBIT is a flexible, modular, massively parallel new framework for carrying out global fits to essentially any BSM theory. First results from GAMBIT will incorporate direct, indirect, solar and relic density searches for dark matter, limits on production of new particles from the LHC and LEP, complete flavour constraints from LHCb, LHC Higgs production and decay, and various electroweak precision observables. In many cases, the likelihoods in GAMBIT are new, updated or computed in significantly more detail than in previous scans. GAMBIT also features interfaces to a range of sampling algorithms, including differential evolution and nested sampling, and the ability to produce both Bayesian and profile likelihood results.

Dark Matter / 102

Prospects on the indirect dark matter detection and a future spectroscopic survey of dwarf spheroidal galaxies

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One of the most promising way to detect dark matter is to look for its annihilation or decay products among cosmic-rays. Recently, more and more interesting results are reported by measurements of cosmic-rays from various kinds of targets such as the milky way galaxy, dwarf spheroidal galaxies, cluster galaxies, etc. Among them, dwarf spheroidal galaxy is one of the nearest, dark matter dominated galaxies and therefore one can expect that a large number of dark matter annihilation/decay signals reach the earth from its halo. In this presentation, we will discuss robustness of the gamma-ray search from the dwarf spheroidal galaxies and give prospects of the dark matter halo survey by the Prime Focus Spectroscopy (PFS) of SuMIRe project.

Gamma-Ray Astrophysics / 105

High performance MeV-GeV gamma-ray astronomy with a time projection chamber

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gamma-ray astronomy suffers from the sensitivity gap between the energy ranges for which Compton telescopes and pair telescopes are efficient. This blank part of the SED of the cosmic sources that are active at high energy hinders the understanding of their nature. In particular the pi0 bump that is dreamt to be signing the hadronic interactions in the cosmic accelerators that produce the highest energy cosmic rays is not easily observed.
We will describe the development in progress of a thin gaseous active target, a time projection chamber, as a high performance pair telescope for gamma-ray astronomy and polarimetry in the MeV - GeV energy range. In particular the characterization of a prototype in a data-taking campaign performed recently on the 1.7 - 74 MeV gamma-ray beam at LASTI (U. of Hyôgo) will be described.

Gamma-Ray Astrophysics / 106

Resolving the blazar gamma-ray emission regions with gravitational microlensing

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The blazars high-energy emission is believed to be produced in the jets, powered by their central supermassive black holes. At the same time the location of the emission region within the jet is presently uncertain - mainly due to its extremely small angular size, far beyond the capabilities of the existing gamma-ray instruments. However, in the rare case of the gravitationally lensed blazars, it is possible to use the natural “magnifying lens” to assist the situation. I will report on the detection of the gravitational microlensing effect for two gamma-ray loud blazars - PKS 1830-211 and B0218+357,- which allowed for the first time to resolve their emission regions, providing strong arguments for their connection with the direct vicinities of the corresponding central black holes.

Dark Matter / 107

A New Method for Determining the Local Dark Matter Density

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Determination of the Dark Matter (DM) density at the solar position is critical to direct and indirect dark matter searches. Additionally, it is important to make this determination with as few assumptions as possible, as results from direct detection searches are used to explore a wide variety of theoretical models, and hidden astrophysical assumptions could bias theoretical

searches. Here we present a Jeans analysis based method for the determination of the local DM density which allows us to limit the number of assumptions we need to make. We fit vertical profiles of baryon and DM density to tracer density and velocity dispersion data via integrated Jeans equations, and from these derive the local DM density. We present tests on mock data, demonstrate the importance of the 'tilt term' which links radial and vertical motions, and also present initial investigations using SDSS and RAVE data.

Dark Matter / 108

Update on scalar singlet dark matter from GAMBIT

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The arguably most simple model for WIMP dark matter is a scalar singlet that couples to the Standard Model sector via the Higgs portal. It is a simple example for beyond-the-Standard Model (BSM) physics, and can be tested with collider, direct, indirect and cosmological probes. In this talk, I will present the first analysis results for the scalar singlet dark matter model that we obtained with GAMBIT (Global And Modular BSM Inference Tool). GAMBIT is a new code that provides an extensive and flexible framework for global scans. Already now, it integrates accurate likelihood functions for a number of direct detection (like XENON and LUX) and indirect detection (like Fermi LAT and IceCube) experiments. It is easily extensible and allows a seamless integration of popular existing theory codes like DarkSUSY and MicrOmegas. Besides presenting results that we obtain for scalar singlet dark matter and generic WIMP models, this talk will provide an overview over the existing and planned dark matter functionality of GAMBIT.

Gamma-Ray Astrophysics / 109

Separation of Electron, Proton and Gamma-ray induced Air Showers with Imaging Atmospheric Cherenkov Telescopes

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Ground-based gamma-ray astronomy is still tackling a major problem: background. Reconstruction techniques exist to distinguish most of the background of hadrons but an irreducible background of electrons and gamma-like protons still remain. I present here a new technique making use of direct Cherenkov light and air shower development that provides a way to efficiently distinguish between electrons and gamma-rays for the first time. In addition to this, the remaining proton background can also be identified. This analysis increases the sensitivity of Imaging Atmospheric Cherenkov Telescopes and allows an improved measurement of the cosmic electron spectrum. I also discuss further applications of this approach to the studies on diffuse emissions, extended sources and cosmic ray composition.

Dark Matter / 110

Gamma-ray emission from the recently discovered dwarf galaxy Reticulum II

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I will present results on the analysis of gamma-ray emission from the recently discovered dwarf galaxy Reticulum II. Using Fermi-LAT data and a suite of background models we quantify the

probability that the observed gamma-ray emission is due to background. Taking into account trials factors, we find emission p-values in the range between 9.8x10ˆ-5 and 9.7x10ˆ-3 and conclude that Reticulum II has the most significant gamma-ray emission from any other known dwarf galaxy. I will also discuss the dark matter content of Reticulum II as derived from kinematic studies of its member stellar population and show that Reticulum II has a dark matter halo similar to other nearby dwarf galaxies. If the gamma ray emission is due to dark matter annihilation, the annihilation cross section is consistent with the s-wave relic abundance cross section. I will conclude by discussing further tests that are needed in order to ascertain the likelihood of this emission to be due to a conventional astrophysical interpretation.

Cosmic Rays / 111

Summary of UHECR Composition Measurements by the Telescope Array Experiment

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We study the chemical composition of Ultra-High Energy Cosmic Rays (UHECRs) primarily using the Xmax technique. The reconstruction techniques use events either seen by two of the TA fluorescence detectors (stereo mode), or by one fluorescence detector, and one fluorescence detector and the TA surface detector (hybrid mode). We compare the observed Xmax distributions to those of shower Monte Carlo simulations, by generating events and analyzing them with exactly the same programs as the data. The results of all analysis are consistent with a light composition. In this talk, a summary of TA chemical composition analysis using the Xmax technique will be presented.

Cosmic Rays / 112

TA Anisotropy Summary

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We present the results of searching for large- and small-scale anisotropy of ultra-high energy cosmic rays (UHECRs) observed for 7 years by the surface detectors of the Telescope Array experiment. The Telescope Array experiment accumulated the largest UHECR data set in the Northern hemisphere. At small angular scales we examine the data for clustering of events and correlations with various classes of astrophysical sources. At large angular scales we published an excess last year – the "hot spot" – at the highest energies by oversampling using a radius of 20 degrees, centered in the constellation Ursa Major. We present the estimation of the statistical significance of this excess using the results of 7 years of observation and show how it manifests itself in various other tests. Finally, we show the result of searching for correlations with the large-scale structures in the nearby Universe.

Cosmic Rays / 113

Radio Detection of Cosmic Rays

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In the last decade significant progress was made regarding the radio detection of cosmic-ray air showers. Mainly at MHz frequencies, air showers emit a coherent radio pulse in the forward direction, which exceeds the galactic radio background at an energy threshold of roughly 100 PeV.

The dominant emission mechanism is the deflection of electrons and positrons in the shower by the geomagnetic field, but also sub-dominant processes as the time variation of the charge excess in the shower play a role. Using digital techniques, the detection method was successfully revived by the LOPES and CODALEMA experiments starting 2003. Nowadays a second generation of digital antenna arrays, like AERA, LOFAR and Tunka-Rex, starts to become competitive with traditional air-shower techniques regarding the precision for the shower direction, energy, and position of the shower maximum. Moreover, the signal properties meanwhile are understood, since recent simulation codes for the radio signal agree with experiments within the current measurement accuracy of the radio amplitude of less than 20 %. This talk will provide an overview on the current status of the radio technique and its future prospects at very dense arrays like SKA, and sparser arrays aiming at the highest energies. In particular the combination of particle detectors and radio antennas seems promising, because their combination provides highest accuracy for the primary energy and mass composition with almost 100 % duty cycle around the clock.

Neutrinos / 114

KM3NeT: Neutrino astronomy and oscillation research in the Mediterranean Sea

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The KM3NeT Collaboration is currently constructing the first phase of a next-generation neutrino telescope on two sites in the Mediterranean Sea: KM3NeT-FR near Toulon (France), and KM3NeT-IT near Capo Passero in Sicily (Italy). Each site will host a three-dimensional array of thousands of photosensors that will detect the Cherenkov light resulting from neutrino interactions in the vicinity of the detector. The KM3NeT detector relies on a novel design for its Digital Optical Modules, housing 31 three-inch photomultiplier tubes enclosed in a glass sphere, which provide enhanced photon counting and directionality performances.
Two configurations have been defined that are optimised for studies in different ranges of energy. KM3NeT-FR will be mainly dedicated to the study of oscillation effects and the measurement of the neutrino mass hierarchy with ˜GeV atmospheric neutrinos (ORCA). KM3NeT-IT will focus on high-energy (TeV-PeV) neutrino astronomy, aiming at the exploration of the all-flavour neutrino sky with unprecedented resolution (ARCA).
This contribution will present the status of the first phase of the KM3NeT detector implementation, and survey the physics potentialities of the telescope with respect to its twofold aim.

Cosmic Rays / 115

Recent results from the Tibet ASγ experiment

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Recent results from the Tibet ASγ experiment will be reported. The presentation will be focused mainly on the high-energy cosmic-ray anisotropy and the research on the Sun's magnetic field by means of the Sun's shadow observed by the Tibet air shower array.

Plenary Talks / 116

Invited talk: Results from the Telescope Array experiment, Hot spots and anisotropy

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The Telescope Array (TA) experiment is located in the western desert of Utah, USA, and observes ultra high energy cosmic rays in the northern hemisphere. The experiment observes cosmic ray air shower at energies > 1 EeV using the fluorescence telescopes and the surface detectors. From first 5 year data, an anisotropy called "Hot spot" in arrival direction of cosmic ray was found at energy >57EeV. In this talk, we present updated result of the "Hot spot" and discuss together with studies on cosmic ray spectrum, chemical composition and other anisotropy studies at highest energy region.

Gamma-Ray Astrophysics / 117

The impact of the Calorimeter-only photons in the Fermi-LAT analysis of VHE sources

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Above tens of GeV, gamma-ray observations with the Fermi Large Area Telescope (LAT) are often dominated by statistical uncertainties due to the low source flux and the limited acceptance. The newly released Pass 8 analysis extended the acceptance of Fermi-LAT to ˜ 2.5 mˆ2 sr over 100 GeV, and made effective an event class that can improve the acceptance at these very high gamma-ray energies: the "Calorimeter-only (CalOnly)" event class. While the conventional event classes require information from the LAT tracker, the CalOnly event class, which is still under development, can recover ˜40-50% of events above 50 GeV without usable tracker information, at the expense of a worse angular resolution and larger cosmic-ray background. In the conference we will describe the working principle, and report on the performance of this new event class using Monte Carlo simulations and real data from astrophysical VHE sources from the recently-released catalog of LAT sources above 50 GeV (2FHL).

Dark Matter / 118

The PandaX Dark Matter Experiment

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PandaX is a dark matter direct detection experiment with xenon located in the China Jinping Laboratory. The collaboration was established in 2009. It's first stage, PandaX-I, started to take data in May, 2014 and stopped running in the end of Oct, 2014. Its first dark matter searching results based on 17.4 live days of data was released in Aug 2014,and disfavor all previously claimed possible dark matter signals by other experiments. The final data analysis results of PandaX-I based on 80.1 live days of data were released in this May with many updates in analysis methods, and verified PandaX-I first results.The second stage, PandaX-II, is being tested and will start operation in this year. The detector will contain 500kg of xenon and we hope it will set the most stringent limit for dark matter after one year of running.

Cosmic Rays / 120

Energy spectrum measured by the Telescope Array experiment in 10^15.6 eV to 10^20.3 eV range

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The Telescope Array (TA) experiment is the largest cosmic ray detector in the Northern Hemisphere. The TA surface detector (SD) array is deployed on a square grid of 1.2 km spacing, covering an effective area of 700 km^2. The TA SD is overlooked by three fluorescence detector (FD) stations: Black Rock Mesa (BRM), Long Ridge (LR), and Middle Drum (MD). The TA BRM and LR stations cover 3 to 33 degrees in elevation, while the TA MD, together with the TA low energy extension (TALE) FD, cover 3 to 57 degrees. In addition, there is a TALE infill array, which consists of 400 and 600 m spaced counters placed in front of the TA MD site at distances ranging from 1.5 to 3 km. The TA SD observes cosmic rays above 10^18.2 eV with the most statistics. The TA FD stand alone measurement, on the other hand, is sensitive to cosmic rays above 10^17.2 eV. Because of a 10% duty cycle, it provides the best statistics in 10^17.2 eV to 10^18.5 eV range. Together with the TALE, the TA FD observes cosmic rays down to 10^15.6 eV. We report the energy spectrum of cosmic rays obtained by a combination of TA SD, TA FD and TALE measurements.

Cosmic Rays / 121

Fluorescence detector Array of Single-pixel Telescopes (FAST) project

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We present a concept for large-area, low-cost detection of ultra-high energy cosmic rays (UHECRs) with a Fluorescence detector Array of Single-pixel Telescopes (FAST), addressing the requirements for the next generation of UHECR experiments. In the FAST design, a large field of view is covered by a few pixels at the focal plane of a mirror or Fresnel lens. We report first results of a FAST prototype installed at the Telescope Array site, consisting of a single 200 mm photomultiplier tube (PMT) at the focal plane of a 1 m^2 Fresnel lens system taken from the prototype of the JEM-EUSO experiment. The FAST prototype took data for 19 nights, demonstrating remarkable operational stability. We detected laser shots at distances of several kilometres as well as 16 highly significant UHECR shower candidates. Moreover, we show a full-scale FAST prototype under construction which consists of a 2x2 PMT camera and a segmented shperical mirror of 1.6 m diameter.

Neutrinos / 122

Multi-Messenger Tests for the Origin of Cosmic High-Energy Neutrinos

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I review various scenarios for the origin of high-energy cosmic neutrinos, and show how multi-messenger data can be utilized to constrain the models. I discuss the present implications and prospects for the future observation.

Gamma-Ray Astrophysics / 123

Blazars as Cosmic-Ray Sources

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Active galactic nuclei, including blazars, have been considered as cosmic-ray source candidates, and GeV-TeV gamma rays can be used as a powerful probe. I will discuss signatures of secondary gamma rays and their multi-messenger connection.

Dark Matter / 124

Galactic Center excess by two Higgs doublet portal scalar dark matter

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We consider a simple extension of the Higgs sector in a Higgs portal dark matter where a real scalar is a candidate for dark matter in the present Universe. This Higgs sector extension allows that its dark matter annihilation suitably explains the observed excess of the gamma-ray flux from the Galactic Center. We identify the parameter region of the model that can fit the gamma-ray excess and satisfy phenomenological constraints, such as the observed dark matter relic density and the null results of direct dark matter search experiments.

Neutrinos / 125

Searches for high energy neutrinos and gravitational waves: recent results in data from the LIGO and Virgo detectors and expectations for the Advanced Detector Era

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Many of the astrophysical sources and violent phenomena observed in our Universe are potential emitters of gravitational waves and high energy neutrinos. Both these probes are cosmic messengers that may escape much denser media than photons. LIGO and Virgo scientific collaborations have carried out joint searches for gravitational waves and high energy neutrinos from IceCube and ANTARES neutrino detectors. I report the results of these coincident analyses and present plans and expectations for the Advanced Detector Era.

Cosmic Rays / 126

Mini-EUSO: Measurement of the Earth's UV background emission from the ISS as a pathfinder for the JEM-EUSO mission

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The key measurement for any experiment which aims to the observe the elusive Ultra High Energy Cosmic Rays (UHECR) from space is related to the UV background in Earth's atmosphere and

at the surface. In view of the planned missions (KLYPVE/K-EUSO, JEM-EUSO) bound for the International Space Station (ISS), a small, compact UV telescope, Mini-EUSO, with the aim to the study the UV night emissions from the Earth, is currently being developed by the JEM-EUSO International Collaboration. The Mini-EUSO detector will be placed at the UV transparent, nadir looking window of the Russian Zvezda module of the ISS. The Mini-EUSO mission has been approved by the Italian Space Agency (ASI) and, under the name "UV atmosphere", also by the Russian Space Agency Roscosmos. Scientific, technical and programmatic aspects of this project will be presented.

Cosmic Rays / 127

The EUSO-TA telescope for observing UHECR

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EUSO-TA is an on-ground prototype of an orbital Ultra High Energy Cosmic Rays detection mission - JEM-EUSO. It consists of two 1 m2 Fresnel lenses and a 2304 pixel focal surface, with resulting field of view of about 10.5x10.5 degrees, and has been working on Telescope Array site in Black Rock Mesa, Utah, USA since the end of February 2015. We show here first observations of calibration sources such as stars, lasers and LEDs, as well as first results from detection of cosmic rays.

Dark Matter / 128

New Results from the CRESST Experiment

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The CRESST (Cryogenic Rare Event Search with Superconducting Thermometers) experiment aims at the direct detection of WIMPs. The recent Dark Matter run was operated for 2 years with a total target mass of 5kg. With respect to previous measuring campaigns the intrinsic radiopurity of CaWO4 crystals and the capability to reject recoil events from alpha surface contamination has been significantly improved. We analyzed the data acquired by two CaWO4 detectors which combine an unprecedented background level with a trigger threshold as low as 300eV. In this talk, we present a new detector design and the results of a low-threshold analysis which set stringent limits for the spin-independent WIMP-nucleon cross section, in particular for low-mass WIMPs. The status of the currently ongoing preparations towards the next phase of CRESST and the strategy beyond will be discussed.

Cosmic Rays / 129

Lens manufacturing for the near future missions of ultra high energy cosmic rays

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We present the lens manufacturing for the near future missions of ultra high energy cosmic rays. The EUSO ultra long duration balloon flight mission and the K-EUSO project have been planed. The balloon optics is compose of two Fresnel lenses and a diffractive lens. The K-EUSO optics is composed of a primary aspherical mirror and a Fresnel lens as a corrector lens. RIKEN will provide Fresnel lenses for both projects.

Gamma-Ray Astrophysics / 130

Highlights from VERITAS studies of TeV astroparticle physics

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VERITAS is an array of four imaging atmospheric Cherenkov telescopes designed to observe gamma-ray emission from astrophysical objects in the energy range from 85 GeV to > 30 TeV. Located at the Fred Lawrence Whipple Observatory in Arizona, VERITAS has operated successfully over seven years with two major upgrades that improved the performance of the array. The scientific goals of VERITAS include understanding the acceleration, interactions, and propagation of TeV particles by observing very high energy gamma rays from extreme environments in both Galactic and extragalactic sources. VERITAS also conducts searches for dark matter in the TeV energy range and performs studies of cosmic rays. In this presentation, we will summarize the current status of VERITAS and highlight recent scientific results.

Gamma-Ray Astrophysics / 131

MAGIC detection of very-high-energy gamma-ray emission from the z = 0.94 blazar PKS 1441+25

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Very-high-energy (VHE, E > 100 GeV) gamma-ray emission from the very distant flat spectrum radio quasar PKS 1441+25 (z = 0.940) was detected in April 2015 with the MAGIC telescopes. Aside from the gravitationally lensed VHE blazar QSO B0218+357 (z = 0.944), also detected by MAGIC, PKS 1441+25 is the most distant VHE blazar detected to date. The VHE detection occurred in April 2015 during enhanced activity of the source at high energy (HE, 0.1 GeV < E < 100 GeV), as measured by the Large Area Telescope on board Fermi. The multi-wavelength light curve shows two distinct flux states occurring during this flare. The broadband spectral energy distribution can be explained by an external Compton model. For the first time, the VHE gamma-ray spectrum was used to indirectly probe the extragalactic background light at redshifts out to z ˜ 0.94.

Cosmic Rays / 132

The calibration of the photo-detector module of the EUSO telescope

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The photo-detector module (PDM) of the EUSO is composed of 36 Hamamatsu multi-anode photomultipliers (64 channels per tube), and 36 photon counting readout ASICs, for a total of 2304 channels. We present the calibration of the detection efficiency of the PDM.

Dark Matter / 133

Domain Wall Formation from Level Crossing in the Axiverse

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We point out that domain wall formation is a more common phenomenon in the Axiverse than previously thought. Level crossing could take place if there is a mixing between axions, and if some of the axions acquire a non-zero mass through non-perturbative effects as the corresponding gauge interactions become strong. The axion potential changes significantly during the level crossing, which affects the axion dynamics in various ways. We find that, if there is a mild hierarchy in the decay constants, the axion starts to run along the valley of the potential, passing through many crests and troughs, until it gets trapped in one of the minima; the axion roulette. The axion dynamics exhibits a chaotic behavior during the oscillations, and which minimum the axion is finally stabilized is highly sensitive to the initial misalignment angle. Therefore, the axion roulette is considered to be accompanied by domain wall formation. The cosmological domain wall problem can be avoided by introducing a small bias between the vacua. We discuss cosmological implications of the domain wall annihilation.

Gamma-Ray Astrophysics / 135

MAGIC detection of the the most distant AGN observed in TeV, gravitationally lensed blazar B0218+357

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The blazar QSO B0218+357 is the most distant AGN (z=0.944) detected so far in the TeV range. It is gravitationally lensed by the galaxy B0218+357G (z=0.68). Very-high-energy (VHE) gamma-ray emission from QSO B0218+357 was detected in July 2014 with the MAGIC telescopes, by measuring the time-delayed image of the flare, detected earlier by FERMI in the GeV range. Its emission enables the study of the EBL properties when the Universe was only half of its present age. In addition, some features in the observed gamma-ray light curves hint that on the top of the time-delay caused by the mass of the lens galaxy, the gravitational microlensing effect may have occurred as well in the case of this system. The gravitational microlensing effect is very sensitive on the sizes of emitting regions at different wavelenghts. Ideas for future MWL observations of B0218+357 and similar systems will be discussed.

Gamma-Ray Astrophysics / 136

Particle acceleration and nonthermal emission from fast winds in active galactic nuclei

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X-ray observations of active galactic nuclei (AGN) are revealing the widespread existence of powerful, baryonic outflows reaching mildly relativistic velocities, seen as variable, blue-shifted absorption lines of ionized heavy elements, in both radio-quiet and radio-loud objects. Sometimes called ultra-fast outflows (UFOs), they are plausibly interpreted as winds driven by the accretion disk and may be the key agents for AGN feedback onto their host galaxies, although their formation mechanism is not yet clear. We discuss the possibility of acceleration of electrons and hadrons in collisionless shocks that are likely to form at different locations in such fast winds, together with expectations for the consequent nonthermal emission from the radio band up to high-energy gamma-rays. We find that: 1) For some radio-quiet AGN with known outflows, synchrotron emission from electrons can account for their radio emission whose origin is not yet clear. 2) For radio-quiet AGN with known outflows and tentative GeV associations such as ESO 323-G77, external inverse Compton emission provide a potential explanation of the gamma-rays. 3) For radio galaxies with known outflows and tentative GeV associations such as 3C111 and 3C120, external inverse Compton emission provide an explanation of the gamma-rays (and partially of the X-rays) that is unrelated to jets. 4) For radio-quiet AGN with known outflows and GeV upper limits such as NGC 4151, lower limits on magnetic fields can be inferred and may point to magnetically driven outflows. We conclude with a discussion of future prospects.

Cosmic Rays / 137

Fast winds in active galactic nuclei as sources of ultra-high-energy cosmic rays

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We discuss the possible production of ultra-high-energy cosmic rays (UHECRs) in fast winds of active galactic nuclei (AGN). Recent X-ray observations of AGN are revealing the widespread presence of powerful outflows of baryonic material reaching mildly relativistic velocities, in the form of variable, blue-shifted absorption lines of ionized heavy elements. Being discerned in both radio-quiet and radio-loud AGN, they are distinct from radio jets and likely subtend much broader opening angles, and have been plausibly interpreted as winds driven by the accretion disk. In such winds, strong shocks can plausibly form at different locations, either external shocks due to interaction with the ambient medium or internal shocks due to inhomogeneities within the flow, wherein hadrons can be potentially accelerated up to UHE. This scenario has some clear advantages compared to the better studied picture of UHECR production in AGN jets: i) the sources can be much more numerous and nearer than radio-loud AGN and hence in better accord with the observed isotropy; ii) the elemental composition of the winds is not only clearly baryonic but also guaranteed to contain heavy nuclei including iron, and hence can more readily account for a mixed composition as indicated by recent measurements. We discuss further implications of this scenario, including expectations for multi-messenger signatures.

Gamma-Ray Astrophysics / 138

The Galactic Center region imaged with MAGIC and variability searches during the G2 pericenter passage

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We present the results from the Major Atmospheric Gamma Imaging Cherenkov (MAGIC) telescope of the search for TeV variability in the very high energy (VHE) gamma ray regime performed in the years 2012-2015 during the pericenter passage of the G2 gas cloud. This gas cloud orbits the Galactic Center (GC) on a highly eccentric trajectory with a pericenter distance of only a few thousand Schwarzschild radii, The GC has been monitored by MAGIC for over three years. Due to its location in the northern hemisphere, MAGIC observes the GC at large zenith angles (58-70 deg), resulting in a higher energy threshold, but an enhanced effective collection area at multi-TeV energies. No variability was detected in the TeV regime, but these observations also gave us the opportunity to study the overall morphology of the TeV sources in the vicinity of the GC in great detail. We will discuss possible source counterparts in other wavelengths and various scenarios for the production of VHE emission in this complex region.

Gamma-Ray Astrophysics / 139

The Fermi GeV excess: testing the point source interpretation

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A spatially extended excess of gamma rays collected by the Fermi-LAT from the inner region of the Milky Way has been discovered by different groups and with increasingly sophisticated techniques of data analysis. I will review the characterization of spectral and morphological properties of the excess when variations of the Galactic diffuse emission are properly taken into account. Recently, there has been strong support for a population of dim millisecond-pulsar-like sources being the dominant component of the excess emission. However, further evidence is needed. I will discuss how it is possible to probe the contribution from unresolved point sources with current multi-wavelength observations, in particular at radio frequencies, and I will present prospects for future observatories [1]. [1] F. Calore, M. Di Mauro, F. Donato, F. Massaro and C. Weniger, In preparation.

Cosmic Rays / 140

Overview and recent results of LHCf

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Large Hadron Collider forward (LHCf) experiment was motivated to study the hadronic interaction relevant to the air shower development at the very forward of the LHC interaction point. LHCf has measured particle production at LHC 0.9, 2.76, 7 and 13TeV proton-proton collisions and 5TeV proton-Lead collisions. LHCf has tested existing hadronic interaction models and provides strong constraints to the future model improvements. In this talk, we will present the major results of LHCf including the recent measurements at LHC 13TeV collisions.

Dark Matter / 141

Asymmetric dark matter and an antineutrino signal

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Under rather generic assumptions, we show that in the asymmetric dark matter (ADM) scenario, the sign of the B-L asymmetry stored in the dark matter sector and the standard model sector

are always the same. One particularly striking consequence of this result is that, when the dark matter decays or annihilates in the present universe, the resulting final state always involves an anti-neutrino. As a concrete example of this, we construct a composite ADM model and explore the feasibility of detecting such an anti-neutrino signal in atmospheric neutrino detectors.

Dark Matter / 142

The CR-WIMP connection in the Galaxy

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Whether or not an exotic component, as the fugitive Dark Matter, contributes to the observed high-energy CR fluxes, is one of the most important open problem in Cosmology. Charged CRs play a key role in this context, since Weakly Interacting Massive Particle annihilations or decays can be a copious source of antimatter in our Galaxy, and the local CR fluxes from conventional astrophysical sources can be predicted with fair accuracy. In this talk, I will show the implications of adopting realistic models for the propagation of CRs in the Galaxy and in the Heliosphere on our ability to provide accurate background predictions. In particular, I will focus on the antiproton channel since the recent measurements by AMS-02 can be profitably used to search for DM contributions or to constrain the DM annihilation cross section in the Galactic halo. Remarkably, this channel has been recently used to argue the DM interpretation of the gamma-ray excess observed from the Galactic Center.

Gamma-Ray Astrophysics / 143

Propagation of CR in the Galaxy with the DRAGON code

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DRAGON is a public software package developed to study CR propagation in the Galaxy. It includes diffusive/advective transport, as well as reacceleration and energy losses, for most of the nuclear and lepton species. Each species can originate from astrophysical sources (e.g., SNR, Pulsars) or from DM annihilations/decays in the halo, making the code very suitable both for studying Galactic high-energy processes and for DM indirect searches. From the beginning, our goal was to design a inhomogeneous model able to properly take into account the different galactic environments. Our model provides accurate calculation of CR fluxes both locally, where they can be directly probed, and at galactic scale, where they predominantly contribute to gamma and synchrotron diffuse emissions. Remarkably, this approach already provided noteworthy improvements in our understanding of FERMI and WMAP signals. In this talk, we present a new update of the DRAGON code which includes several new features incorporated to describe spatially dependent and anisotropic diffusion.

Gamma-Ray Astrophysics / 144

2FHL The second Catalog of Hard Fermi-LAT Sources

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The Fermi Large Area Telescope (LAT) has been routinely gathering science data since August 2008, surveying the full sky every three hours. The first Fermi-LAT catalog of sources detected above 10 GeV (1FHL) relied on three years of data to characterize the >10 GeV sky. The improved acceptance and point-spread function of the new Pass 8 event reconstruction and classification together with six years of observations now available allow the detection and characterization of sources directly above 50 GeV. This closes the gap between ground-based Cherenkov telescopes, which have excellent sensitivity but small fields of view and duty cycles, and all-sky observations at GeV energies from orbit. In this contribution, we will present the second catalog of hard Fermi-LAT sources detected at >50 GeV. We will discuss the properties of the extragalactic and Galactic source populations with an emphasis on the detection of spatially extended sources in the plane of our Galaxy.

Neutrinos / 145

IceCube Cosmic Neutrino events from Star-forming galaxies.

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Sources of the 53 high energy neutrino events detected by IceCube with energy between 20 TeV and 2.7 PeV is one of the outstanding puzzles in recent years. Suggestions range from Galactic to extragalactic sources, and from standard model interactions to dark matter decay or annihilation. We perform a statistical analysis of the distribution of these neutrino events and astrophysical sources. Our results suggest correlation between the IceCube neutrino events and star forming galaxies with at least 3-sigma significance. We also perform a multi-messenger study of gamma rays and neutrinos from these sources and constrain star formation rate and environment parameters based observations.

Cosmic Rays / 146

The Possible Extragalactic Source of Ultra-High-Energy Cosmic Rays at the Telescope Array Hotspot

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The Telescope Array (TA) collaboration has reported a hotspot of 19 ultrahigh-energy cosmic rays (UHECRs), offering an opportunity to study their origin. Using a universal model with one source and energy-dependent magnetic deections, we show that the distribution of the TA hotspot events is consistent with a single source hypothesis, and that the chance probability of this distribution appearing from a homogeneous distribution is 0.2%. We describe a Monte Carlo Bayesian (MCB) inference approach, which can be used to derive parameters of the magnetic fields as well as the source coordinates, and we apply this method to the TA hotspot data, inferring the location of the likely source. We discuss possible applications of the same approach to future data.

Neutrinos / 147

TeV Gamma rays with ICAL-INO

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The feasibility of the detection of TeV gamma-rays from astrophysical objects has been carried out using the INO-ICAL detector. The detection of very high energy gamma-rays has been followed by the detection of down going muons produced through the electromagnetic showers initiated by gamma-ray in the atmosphere. As the produced muons through this process are of same charge ratio, they might be result in the enhancement of mu+ to mu- ratio at very high energy (above 100 GeV). The ICAL detector is proposed to be a magnetised calorimeter with an average magnetic field of nearly 1.3 T. So the signature of gamma-rays could be addressed very easily through this technique.

Neutrinos / 148

The landscape of flavor composition of high-energy astrophysical neutrinos

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IceCube has confirmed the existence of the long-sought high-energy astrophysical neutrinos. Recently, the flavor composition of the diffuse flux, that is, the proportion of electron-, muon-, and tau-flavor in it, was measured for the first time. This rich observable can reveal information about physical conditions in the production, propagation, and detection of neutrinos, including whether there is new physics involved. We present theoretical expectations for the flavor composition at Earth by exploring all possible flavor compositions that leave the astrophysical sources. We explicitly show that the region of accessible flavor composition at Earth is surprisingly small, regardless of the neutrino mass hierarchy and of the experimental uncertainty on the mixing parameters. This remains true even in the presence of a broad class of new physics effects during propagation. Furthermore, we are able to clearly identify what regions of the flavor space can be accessed only by new physics, and of what type. In particular, in the case of neutrino decay under a normal mass hierarchy, we demonstrate the usefulness of the flavor composition by using the present IceCube results to improve the bounds on neutrino lifetimes by several orders of magnitude. The planned volume upgrade, IceCube-Gen2, would be able to strengthen these claims.

Gamma-Ray Astrophysics / 149

High-energy emission from Gamma-Ray Bursts

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Our understanding of high-energy emission from Gamma-Ray Bursts has greatly advanced with observations from the Fermi gamma-ray space telescope. I will review the Fermi observations, with particular emphasis on the surprising detection of both prompt and temporally extended emission at high energies. I will also discuss the prospects for detection of GRBs with the High Altitude Water Cherenkov (HAWC) and Cherenkov Telescope Array (CTA) experiments.

Dark Matter / 150

Prospects for dark matter discovery with inelastic transitions of xenon

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Dark matter can excite the xenon isotopes 129Xe and 131Xe through a spin dependent interaction. The excited isotopes quickly decay giving a 40 keV and 80 keV photon, respectively. This signal is very distinct from the usual signal from elastically scattering dark matter and, if discovered, would provide clear evidence against the usual spin independent interaction. I discuss the prospects of discovering this inelastic signal with up-coming tonne-scale two-phase xenon direct detection experiments.

Gamma-Ray Astrophysics / 151

Galactic VHE gamma-ray astrophysics with H.E.S.S.

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H.E.S.S. is a hybrid array of five imaging atmospheric Cherenkov telescopes operating in the very-high-energy (VHE) gamma-ray energy range ˜20 GeV to 100 TeV. With its unprecedented sensitivity, broad energy range, fast slew time, and Southern-hemisphere location in Namibia, H.E.S.S. provides an unparalleled, high-quality view of the VHE Galaxy, in a multi-messenger approach that builds on agreements with many collaborations, including in particular Fermi-LAT, IceCube, ANTARES and VIRGO/LIGO. H.E.S.S. has conducted deep observations of several key Galactic regions of utmost importance for understanding the mechanisms at work accelerating cosmic rays and producing VHE gamma rays. Among them are the Galactic Center and Ridge, the Crab Nebula, the energetic Vela pulsar, and several binary systems such as PSR B1259-63 and LS 5039. To capitalize on these observations, recent years have seen a tremendous effort in the design, implementation, and optimization of analysis techniques for both monoscopic and stereoscopic events, as well as standardized analysis pipelines for processing large datasets like that of the Galactic Plane Survey. The comprehensive Survey is the culmination of a decade-long, ˜2800-hr observation program and is the first high-resolution (˜0.1 deg) and sensitive (˜2% Crab Nebula point-source sensitivity) survey of the Milky Way in TeV gamma rays. A public release of this legacy H.E.S.S. data, including a source catalog and source population studies, is also on schedule for 2015 and will be presented. This presentation will highlight the newest hybrid data and observations utilizing the fifth, large telescope, as well as spectacular new findings from the Large Magellanic Cloud, the powerful particle accelerator situated in the inner region of the Galactic Center, high-precision measurements of the iconic supernova remnant RX J1713.7-3946, and a handful of brand-new VHE source discoveries from the Survey.

Gamma-Ray Astrophysics / 152

Natural model for the Fermi bubbles and Galactic haze

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We show that the Fermi Bubbles and the Galactic haze are naturally interpreted as inverse-Compton and synchrotron emission from the same spectrum of cooling cosmic ray electrons. This avoids the ad-hoc spectral features and superfluous acceleration mechanisms typically assumed. The model implies that the bubbles originated 2-3 Myr ago, the mean magnetic field in the haze region is ˜3\muG, and the radiation field in the bubble is dominated by starlight with mean

energy density >2eV/cm^3. These parameters imply that the bubbles accelerate cosmic ray protons (iron nuclei) up to energies of ~5·10^{17}eV (~10^{19}eV).
In contrast, a hadronic model fails to naturally account for the gamma-ray spectrum of the bubbles, in particular once the haze-emitting electrons are taken into account.

Gamma-Ray Astrophysics / 154

Particle acceleration observed in gamma-rays

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Gamma-rays give us a view on the acceleration some of the most energetic particles in the universe. These particles are usually thought to be accelerated in (relativistic) shocks. However, with the advances in Particle In Cell simulations over the past years it became clear that magnetic reconnection is also a compelling alternative. In this talk, I will discuss what gamma-ray observations can tell us about these two options. I will discuss this question for different gamma-ray source classes, as Supernova Remnants, Jets of Active Galactic Nuclei and Pulsar Wind Nebulae.

Dark Matter / 156

New physics searches at the LHC: Where do we go with run II

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Two LHC experiments, ATLAS and CMS restarted their operations so called Run-2 from June this year. The center of mass energy is increased to 13 TeV, with which the significant enhancement in sensitivity is anticipated for the new physics. The talk will briefly review the Run-1 results and will discuss the prospects for the Run-2. The status and the early results from the Run-2 will be also shown.

Neutrinos / 161

Observations of the diffuse astrophysical neutrino flux with IceCube

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IceCube is a cubic-kilometer neutrino observatory buried deep in the ice sheet at the geographic South Pole. The data from its first few years of operation have revealed an excess of high-energy neutrino events in multiple detection channels that is incompatible with purely atmospheric origins, which we interpret as evidence for a flux of neutrinos from unresolved astrophysical sources. At the same time, no point sources of neutrinos have been detected. This talk will provide an overview of IceCube's constraints on the energy spectrum and neutrino flavor composition of the diffuse astrophysical neutrino flux.

Plenary Talks / 166

Invited talk: Mapping dark matter in the Milky Way

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The presence of dark matter in spiral galaxies was inferred long ago by measuring the rotational speed of the gas across each galaxy. Applying the same technique to the Milky Way, a spiral itself, is much more challenging due to our peculiar position and thus the Galactic distribution of dark matter remains poorly constrained to this day. In this talk, I shall introduce two important developments for dynamical studies of the Milky Way. First, a new compilation of kinematic measurements is presented and used to pinpoint with unprecedented precision the rotation curve of our Galaxy. Second, an exhaustive array of observation-based baryonic models is constructed to set the contribution of stellar bulge, stellar disc and gas to the total gravitational potential. I will then quantify the discrepancy between these two components and derive the latest constraints on the dark matter distribution. The implications for modified Newtonian dynamics are also briefly examined. I shall end with a discussion of future directions to improve our mapping of the dark matter distribution in the Milky Way.

Plenary talks / 167

Invited talk: Galactic Sources of Very High Energy Gamma-Ray Emission: Highlights from Ground-Based Experiments

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The three major ground-based gamma-ray experiments, H.E.S.S., MAGIC and VERITAS have carried out an extensive program of very high energy (VHE) observations of the Universe and revolutionized our view of the VHE gamma-ray sky. Studies at TeV energies are valuable for exploring the underlying energetic particle populations in Galactic systems. Galactic gamma-ray sources include shell-type supernova remnants (SNRs), pulsar wind nebulae (PWN), X-ray binary systems, pulsars, and the Galactic Center region and its halo, with PWN in particular, comprising the bulk of known galactic TeV gamma-ray emitting objects. H.E.S.S. has also carried out an unprecedented survey of the Milky Way Galaxy, revealing several Galactic VHE sources, and VERITAS has carried out a survey of the Cygnus region, covering targets previously studied by Milagro. The study of the Galactic VHE sky by ground-based IACTs is complemented by the recently-commissioned HAWC array in Mexico. We will report on some of the highlights of the VHE sky as revealed by ground-based atmospheric Cherenkov telescopes.

Plenary Talks / 168

Invited talk: Next Steps in Experimental High-energy Neutrino Astrophysics

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IceCube's discovery of a diffuse flux of high-energy astrophysical neutrinos has vitalized the emerging field of neutrino astronomy, but many questions remain unanswered. The source populations remain unidentified, and other expected astrophysical high-energy neutrinos, such as those from the GZK process, remain undetected. Details of the energy spectrum and flavor composition also are yet to be understood. The next generation of neutrino observatories will shed light on these and other questions. Large-scale ice and water arrays will instrument from 10 to 100 square kilometers with optical and/or radio detector elements to detect the Cherenkov and Askaryan radiation from neutrino interactions. Other novel approaches include large balloon-borne detectors, or searching for tau neutrino conversion in adjacent mountains. I will survey the status and prospects for a number of these experiments and detail how each aims to further the field in the coming years.

Closing Cermony / 169

Summary & Conclusion

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Gamma-Ray Astrophysics / 170

Highlights from the H.E.S.S. telescope array: gamma-ray astronomy from 20 GeV to hundreds of TeV's

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H.E.S.S. is an array of Imaging Atmospheric Cherenkov Telescopes observing the gamma-ray sky beyond ˜20 GeV. In the course of the first 10 years of operation, this experiment significantly contributed to the field of ground-based gamma-ray astronomy. In 2012, a fifth telescope was added at the centre of the original array. This large telescope of 28 meters diameter improves the performance of the array, including a lowering of the energy threshold down to a few tens of GeV. This new phase of the experiment provides the first hybrid array of Cherenkov telescopes. In this talk, I will highlight new results obtained with the newest hybrid array and observations with the fifth, large telescope, of Galactic and Extragalactic sources, such as the Vela pulsar, the Crab nebula and a handful of important Active Galactic Nuclei. I will also present striking new findings from the accelerator of ultrarelativistic cosmic-rays located in the Galactic Centre region, the Large Magellanic Cloud, new VHE source discoveries from the upcoming H.E.S.S. Galactic Plane Survey, indirect dark matter searches, among other results from the legacy of H.E.S.S. observations.

Gamma-Ray Astrophysics / 171

Pulsars and pulsar wind nebulae at high energies

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Pulsars and their synchrotron nebulae have been extensively observed in the gamma-ray energy band only in the last 10 years. With the advent of the Fermi satellite the number of known gamma-ray emitting pulsars has increased by one order of magnitude, touching the 150 mark. On the other hand, the last generation of imaging Cherenkov telescopes proved that the pulsar wind nebulae are the most populous class of sources radiating in the VHE (>100 GeV) sky. The now feasible population studies, together with the available high-precision spectral and morphological measurements led to important developments in understanding the physics of the neutron star magnetosphere and their surroundings. In addition a long-term monitor of the gamma-ray sky has revealed evidence of flux variability from the Crab nebula and the PSR J2021+41 pulsar, challenging the constant-emission paradigm. A couple of more unexpected discoveries moves even forward this ongoing "pulsar revolution". On the one hand, a new spectral component emerging above the expected synchro-curvature cutoff was observed in two young pulsars, the Crab and the Vela pulsars. In the case of the Crab, this new component reaches the TeV energies, requesting an extreme particle acceleration up to a 5x10ˆ6 Lorentz factor. On the other hand, the old and recycled millisecond pulsars, with 10ˆ-4 weaker magnetic fields with respect to the young pulsars, were established as a new class of gamma-ray emitters.

Gamma-Ray Astrophysics / 172

X-ray and Gamma-ray Study of Supernova Remnants

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Diffusive shock acceleration (DSA), a well-developed theory of the acceleration process at work in supernova remnants (SNRs), lays the foundation for the SNR paradigm of the CR origin, though key problems are yet to be solved. Determining the acceleration efficiency is one of the key issues, where the term "acceleration efficiency" carries two different meanings; one is related to the maximum attainable energy, and the other is the energy content of CRs. Synchrotron X-ray emission produced by highest energy electrons with energies of tens of TeV, and gamma-ray emissions either by relativistic electrons via IC scattering or by high-energy protons via pion-decay can provide information about the acceleration efficiencies at SNR shocks. We will report on our recent work on X-ray and GeV gamma-ray observations of some supernova remnants. Also we will discuss prospect for the upcoming X-ray observatory, ASTRO-H, which allows us to perform X-ray spectroscopy of extended objects with unprecedented spectral resolution (7 eV).

Gamma-Ray Astrophysics / 173

The ASTRI mini-array and its scientific prospects in the framework of the Cherenkov Telescope Array

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In the framework of the international Cherenkov Telescope Array (CTA) observatory, the Italian National Institute for Astrophysics (INAF) has developed a large field-of-view (9.6 degrees), dual-mirror, small-sized, end-to-end telescope (ASTRI SST-2M). This prototype has been installed at Mt. Etna (Italy) on September 2014, and it is currently undergoing engineering tests. Soon after the scientific validation of the ASTRI SST-2M prototype, INAF will be ready to lead, in synergy with the Universidade de Sao Paulo (Brazil) and the North-West University (South Africa), the deployment at the final CTA southern site of the ASTRI mini-array composed of nine ASTRI SST-2M telescopes that are proposed to be a precursor to CTA. The ASTRI mini-array will overtake the sensitivity of current IACTs above few TeVs up to about 100 TeV, and will be well suited to perform unprecedented scientific observations of known and predicted bright TeV emitters, both Galactic and extra-Galactic. In addition, it will also allow us to address problems in fundamental physics such as the particle nature of Dark Matter. In this contribution, we review the main ASTRI mini-array scientific prospects.

Welcome & Information / 174

Welcome Address and Local Information

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Welcome to TeV Particle Astrophysics 2015. This is the 10th edition of TeVPA in Kashiwa, near Tokyo. This 5-day conference aims to provide the stage for the most recent advances in the booming field of Astroparticle Physics, bringing leading members of the scientific communities that are contributing to its success.

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Welcome Address by Prof. Takaaki Kajita

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Opening Address of TeVPA by Dr. Gianfranco Bertone

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Information by Prof. Masahiro Teshima

Cosmic Rays / 179

The knee of the proton spectrum

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Using a LHAASO wide field of view Cherenkov telescope and the ARGO-YBJ resistive plate chamber array as 4300m a.s.l., the energy spectrum of cosmic hydrogen and helium nuclei (H&He) between 100 TeV and 3 PeV is measured. A clear knee feature is observed around 630 TeV in the spectrum with an energy resolution of about 25%. Below 300 TeV, the data from direct charge measurements provide rather precise measurements of fluxes of H, He and other heavier nuclei. In this paper, we discuss the knee feature of the pure proton spectrum indicated by the newly published H&He spectrum. We also estimate the systematic errors of the spectrum measurement with a mixture of nuclei. We propose a way to minimize the systematic error in measurement of the knee feature of the cosmic ray spectrum.

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The Large High Altitute Air Shower Observatory by Dr. H. He